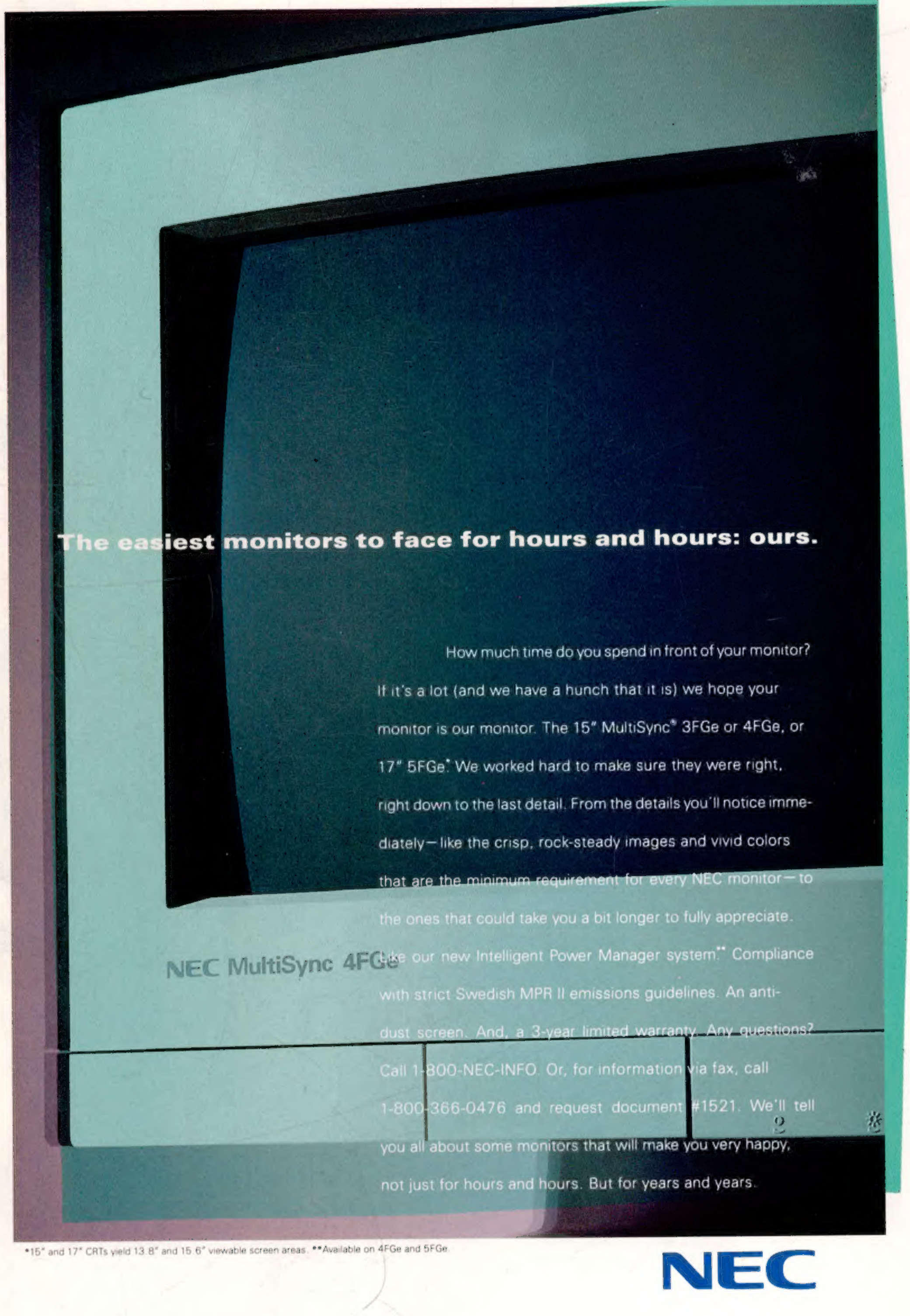




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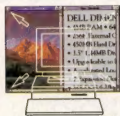
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(Other systems featured are not pictured.)

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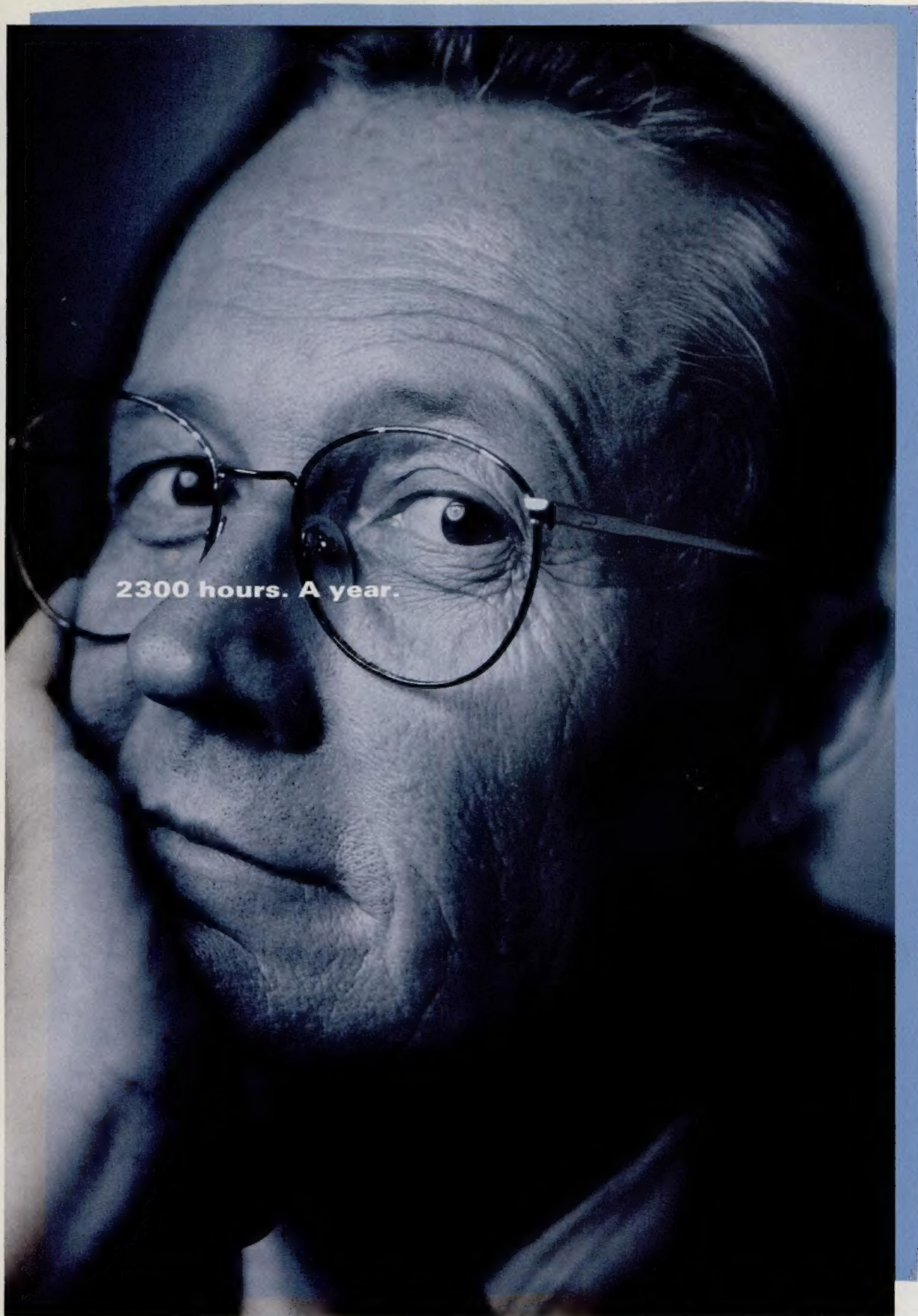
Our Dell Dimension XPS P60 systems are all Pentium processor based, and our i486 systems can easily be upgraded to Pentium Overdrive. Every Dell Dimension system on this page features accelerated local bus video. The rest of the specs read like a power user's wish list of the latest technological innovations.



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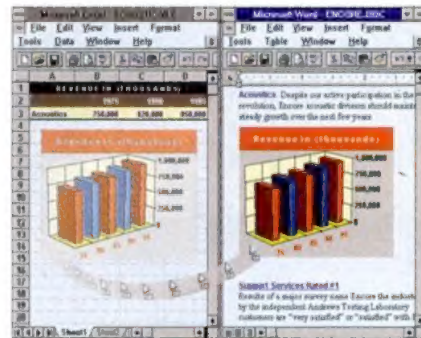
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Inside

How fast is fast enough? Sure, that 486 on your desk is a lot faster than the machine you had a year or two ago, but does it really shine when running today's big applications?

For most of us, the answer is no. As soon

as we have a machine that runs our applications fast enough, new applications come along that demand more speed. Applications that take full advantage of object linking and embedding, on-screen video, and moving large graphics can stress our existing machines to their breaking points.

At the same time, the kind of processing power available for a fixed amount of money is staggering. A year ago, \$3,000 would have gotten you a very nice unit based on an Intel DX2/66. Today, that same \$3,000 can get you a Pentium-based unit that can run nearly twice as fast. In fact, we now see a huge range of Pentium machines, as evidenced in our roundup of 31 new systems, ranging in price from \$2,795 to nearly \$8,000.

The rise of the Pentium is far from the only thing happening in Intel's world of processors, however. This month, Intel has introduced the Intel DX4, the fastest processor yet in its 486 family. In this issue's First Looks section, we see the first 100-MHz DX4-based desktops, along with laptops running the 75-MHz version of this chip. Such machines fill the gap between DX2 and Pentium units.

Senior associate editor Brian Nadel and project leader Tami Peterson head the editorial and Labs teams responsible for our PC re-

views. Senior editor Don Willmott looks for ways to bring you up-to-the-minute info on the latest shipping products. In this issue, the two



**Willmott on DX4s, Nadel on Pentiums:
How fast can they go?**

teams work together to bring you the best PC coverage possible.

Of course, all this hardware wouldn't be useful without the new applications. Elsewhere in this issue, we take a look at the underlying architecture of "Chicago," Microsoft's long-awaited upgrade to Windows 3.1. Chicago is still months away, but contributing editor Jeff Proise leads us in a look at the essence of the change. Pieces on e-mail and sound boards round out our coverage.—*Michael J. Miller*

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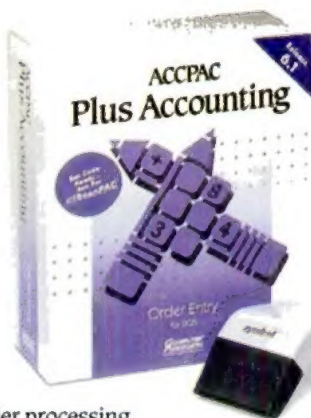
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Pentium PCs

Unleashing the Power of Pentium

BY ROBERT S. ANTHONY

Pentium PCs with local-bus technology are rapidly becoming the power users' system of choice. As the bottom falls out of Pentium PC prices, more users will be able to take advantage of Intel's most powerful PC processor. *PC Magazine* tests 31 Pentium systems that put data on the fast track.....114



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Chicago: Under Construction



BY JEFF PROSISE AND MICHAEL J. MILLER Even as the coding continues, one thing is already clear: Microsoft's next-generation desktop operating system—code-named Chicago—is a clean break with the DOS/Windows past. Finally, the millions of mainstream Windows users will get their bootable, 32-bit, multitasking, multithreaded OS. At this stage in the game, it's too early to judge performance and the hardware you'll need. But work on object orientation, built-in networking, and a brand-new Windows interface is already well under way. We look at the technology and the promises...183

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The E-Mail Personae

BY RICK AYRE AND TED STEVENSON The slow but constant evolution of the e-mail market reveals one truth: Each package reflects the nature and personality of the organization that produces it. The packages in our e-mail round-up take distinct approaches to message storing and handling, making it imperative that you choose the product that best suits your company's persona. A consideration of several additional features, such as rules and routing, may also influence your decision.251



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Sound Boards:
Big Audio Dynamite

BY JOHN R. QUAIN Sound board sales have taken off, but how valid are claims of CD-quality sound? Is business audio reality or hype? PC Magazine tests 24 16-bit sound cards for everything from audio quality to installation, ease of use, and suitability for business applications, professional audio, and games.207

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Follow the adventures of Xanthia, heroine of The Hand of Fate (page 441).

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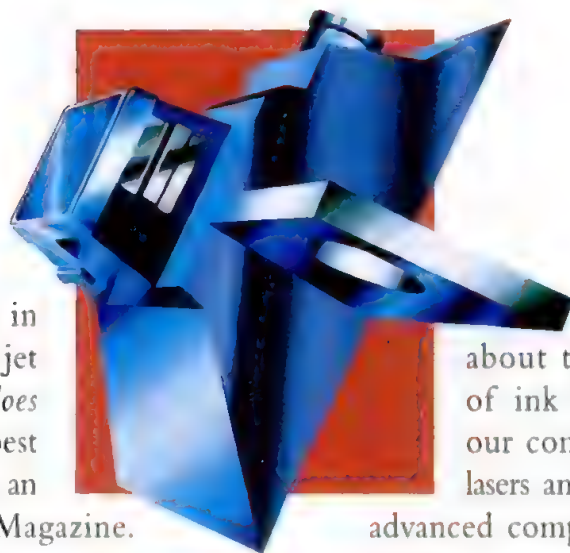
It's amazing how computers can solve just about any problem (page 446).



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We welcome letters. However, we cannot look up stories from past issues, recommend products, or diagnose problems with your PC by phone. Send your written questions, complaints, and compliments to *PC Magazine*, One Park Ave., New York, NY 10016-5802. Please include a daytime telephone number. Send electronic mail to MCI Mailbox 157-9301, to CompuServe address 72241,104, Internet address 157.9301@mcimail.com, or to PC MagNet (see below). *PC Magazine's* general number is 212-503-5255. The West Coast Operations number is 415-378-5500.

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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 486/33M's.

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ordinary computer
users in a room for
30 minutes with
one extraordinary
program to see
what they could
come up with.**

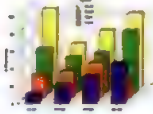
Thompson & Associates

December 30, 1993

Mike Sawyer
Thompson & Associates
1515 Washington Street
Atlanta City 30 0010

Dear Mr. Sawyer:

It was a pleasure meeting you at our on-site visit of 11 December 1993. The following is a quick overview of the issues discussed and our preliminary findings.



As you can see in our initial assessment, the Thompson & Associates team has identified a number of key areas for improvement. We believe that the information we have provided and the recommendations we have made will help you to achieve your goals. The Thompson & Associates team will continue to work with you to ensure that the project is completed on time and within budget.

You can expect to see our detailed report on 15 January 1994. We will work to provide you with key topics to ensure your success and target the future negotiations.

Have a very happy holiday season! I look forward to seeing you in the New Year!

Sincerely,

Mike Thompson
Principal

1515 Washington Street, Atlanta, GA 30303, Tel: 404.555.1234

Mike, Eaton Town, NJ

Kusab Enterprises, Inc.

1700 Courtney Way, Seattle, WA 98101

Paul Carter
President
Carter & Christensen
300 Lincoln St.
Seattle, WA 98101

December 10, 1993

Dear Paul:

Thank you for attending our recent seminar in our area. I have enclosed the following information for your review.

- A transcript of the seminar and procedures
- A brochure detailing our background and publications

Let me also share this information and have any one who could not attend call Paul Carter at 206.739.7015. It is my goal to have the Thompson & Associates team system (ATS) operate best for you!

Category	Paul	Mike
Teacher	✓	
Parent		✓
Student	✓	
Administrator		✓
Volunteer	✓	
Other		✓

Building with special support for the type of system is essential before purchasing equipment or funds. It is important to secure teachers and parents in the ATS in the early stages of your implementation to ensure the system will be successful. I will be glad to provide you with a copy of the ATS manual and any local business assistance or support in the ATS.

Thank you again for our interest and participation in our seminar. If you have any questions or comments, please feel free to contact me at 206.739.7015. I look forward to working together to bring the truly worthwhile service to the community.

Sincerely,
Lisa

Lisa, New York, NY

Introducing the document WordPerfect

Memo

To: Susan Fournier
From: Sharon
Date: December 10, 1993
Regarding: I'm going on vacation!

After working my fingers to the bone, I'm proud to announce that I'm taking a long weekend. I'll be spending five relaxing days at the Blue Heron Beach Resort in Charleston.

December 20 - 24

I've arranged for the following people to cover my absence:

Account	Ernestine Smith
Administrative	Sharon
Adverse Board	David G. Smith
Accounting	Sharon
Charitable Foundation	Sharon
Gift Certificates	Sharon
Global Photography	Maria Montoya

Thanks!

See you all soon,
Sharon.

Sharon, Poway, CA

ECONeWS

Organization Summary

The following is a summary of the organization's structure and the roles of the various departments. The organization is a non-profit organization that provides services to the community.

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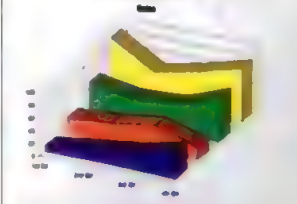
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Issue 1, 1993

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EcoService



Value



Dan, Buffalo, NY



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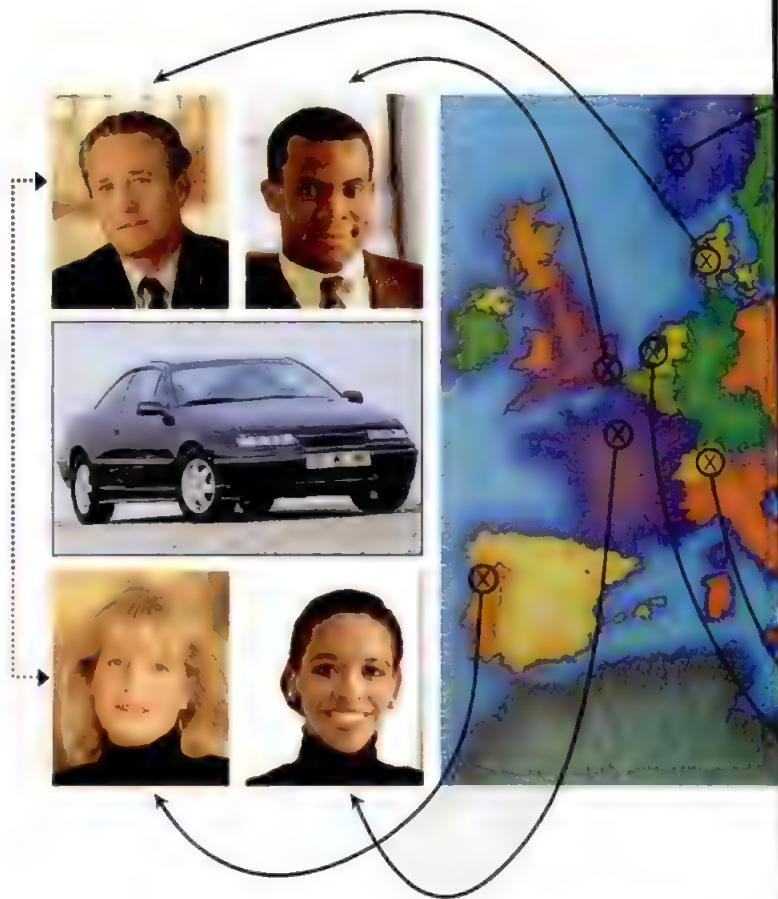


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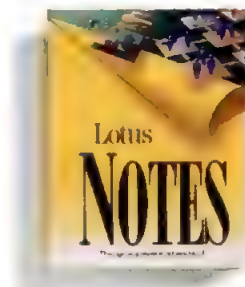
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CAN REACT QUICKLY.

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S USES NOTES TO BIG IS YOUR PROBLEM?

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CIRCLE 086 ON READER SERVICE CARD

Letters

FRANKLY, ROSEBUD, I DON'T GIVE A DAMN

I read Michael J. Miller's column on voice recognition ("Conversations with My PC," January 25, 1994) with great empathy, and I just had to relate my experience with one of these voice recognition systems. After following the setup instructions, I made my first attempt to "talk" to my computer.

To make a long story short, my attempt failed miserably. An hour-long conversation on the phone with technical support helped me get the contraption to work, sort of. But after trying to train the Voice Pilot to understand my Southern accent, I ended up having to make my voice sound like a cross between Rhett Butler and Orson Welles to get the thing to work. My kids thought this was hilarious, but it was far too frustrating. After all, I could just point and click to perform the same function. The moral of the story is simple: One click is worth a thousand words.

David E. Mills
Enterprise, Alabama

DVORAK'S A SOHO DODO

John C. Dvorak strikes again by bashing something of which he has no knowledge or experience. In his January 25, 1994, column, "SOHO? Ho Ho!" Dvorak states, "Too many people thought a Commodore 64... was a computer that they might actually use," and he goes on to remark that it worked well as a doorstop.

I certainly found the Commodore 64 to be both useful and cost-effective. I ran a home business on it and used it for word processing and database management. With only about 32K of available RAM and no hard disk, the power of the Commodore 64 and its software was truly remarkable.

Dvorak should step back and look at what the programmers of yesteryear could do with the limited resources of the Commodore 64's hardware, rather than brag about his new applications that require a minimum of 4MB of RAM and 20MB of hard disk space.

Barry Kutner
Yardley, Pennsylvania



Who needs voice recognition? I can point and click for the same function.

The original, affordable, but underpowered home computers don't deserve Dvorak's denigration. Animated, musical slide-out menus with selections accessible by touching the screen? The light-pen program for the 8-bit Atari computer was similarly equipped. The bookmark feature in WordPerfect 6.0? PaperClip for the Atari allowed as many as 26 bookmarks. Using software to prepare your taxes? Oh, well, I was able to do the necessary calculations on my Atari. And my Atari helped me understand bytes, disk operating systems, and computer architecture long before I ever bought my MS-DOS machines.

Jared Lum
Honolulu, Hawaii

Dvorak ought to take a brief tour of the real world. To say that "almost everyone who needs or can use a computer for anything already has one" is a true stretch of the imagination.

The question "What is a good starting setup?" is all too common in computer stores around the country. Contrary to what Dvorak may think, these first-time users are home or small business consumers who cannot afford the latest, greatest power machines. They are looking for solid, inexpensive machines that

they won't have to tinker with, machines they can use right out of the box. They aren't looking for the complexities of high-end software; a simple integrated package will suffice.

SOHO is a genuine market, and it's a market that wants vendors to follow that old acronym KISS (Keep It Simple, Stupid). I believe that if you keep it simple, they (the buyers) will come.

William J. Godsil
Bradford, Massachusetts

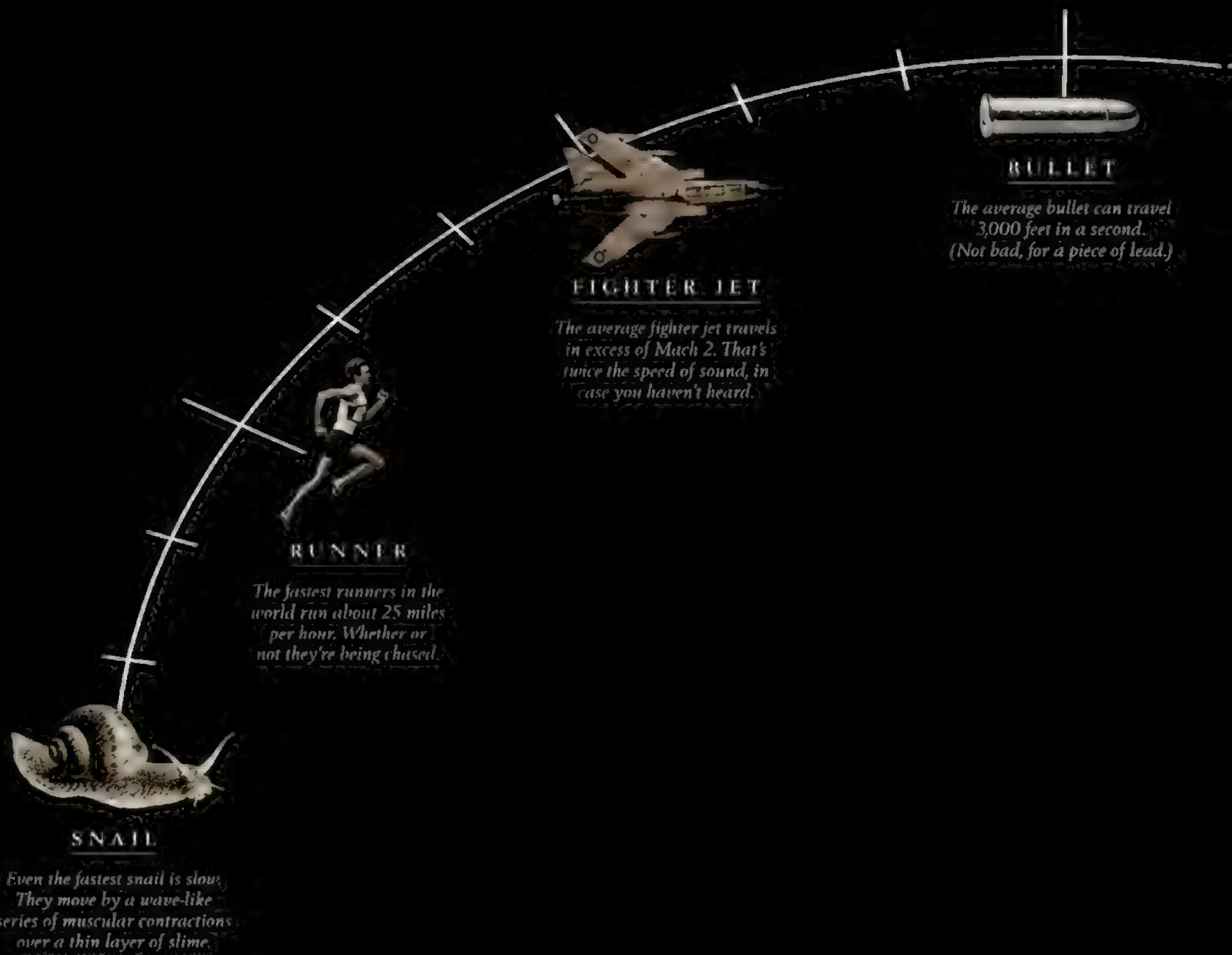
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PC Magazine's Service & Reliability survey (January 11, 1994) scores Acer "below average" for satisfaction with technical support. While I do not question the validity of your survey results, we do not believe that the survey accurately reflects the significant customer service improvements we initiated earlier this year.

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LETTERS

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Olend King
Vice President, Customer Service
Acer America Corp.
San Jose, California

A GIFT FROM ABOVE

Kudos to Jeff Prosis for his helpful Tutor column "Empowering Physically Challenged Users" (January 11, 1994). I was born with cerebral palsy and am acquainted with coordination problems myself. For me the utilities mentioned, many of which were written by Prosis, are a godsend. Some technologies that enable disabled persons today may tomorrow be used to enable robots to walk on Mars.

Rebecca S. Walsh
Oak Park, Michigan

THE COSTS OF CONNECTING

The informative article "On-line to Tomorrowland" (Trends, January 25, 1994) explored some of the potential of on-line services. But while on-line services can be extraordinary resources for information and entertainment, they will never get the customer base they want until they can find a way to lower the ridiculously high connect charges. The quaint Imagination Network (formerly The Sierra Network), which used to be very affordable, has now joined the big guns in technology and unfortunately in price. The new pricing structure will push my current costs up to a prohibitive level by the end of 1994. With such outrageously high rates I'll be forced to cancel my membership.

Richard F. Perry III
York, Pennsylvania

THE REAL COMPETITION

Though I enjoyed reading Bill Machrone's column "Chipping Away at Intel?" (January 25, 1994), it would have been more interesting had he concentrated on the real competition to Intel's hegemony: the DEC Alpha and the PowerPC. Cyrix's M1 sounds great on paper, but one has to wonder how the company plans actually to produce a part that is so complex.

Discussing superscalar and superpipelining technology helps to keep readers up-to-date and aware of potential technology shifts, but columnists do readers no favors by highlighting an implementation that is likely to arrive either very late or stillborn.

Leonard R. Goldberg
New York, New York

TELL 'EM WHAT YOU WANT

Like Jim Seymour, I too have tried to break the paper chain ("Breaking the Paper Chain," January 25, 1994). To use my HP LaserJet IIP as a duplex printer I routinely print odd pages first and then refeed them, faceup, and print the even pages. With a macro and decent spooling programs, this is a relatively painless process.

But last year I suggested to Microsoft that it simplify duplexing on conventional printers by adding an option to print odd or even pages of a document. This suggestion was eventually incorporated into subsequent versions of Microsoft Word for Windows, and Microsoft even expressed its appreciation for my suggestions on a nifty preprinted postcard. I urge other *PC Magazine* readers with helpful ideas to pass them on to their favorite software companies. We, the end users, can make a difference.

Dean J. Earlix
Auburn, Alabama

STEADY AS SHE GOES

In response to Barry Hindin's complaint (Letters, "Printer Praise and Problems," February 8, 1994) about flickering lights caused by the HP LaserJet 4L's instant-on feature, I'd like to report that I have no such problem. I have incandescent lights on the same circuit as my printer, PC, and monitor, and there's not a flicker in sight.

Bill Trelor
via PC MagNet

CORRECTIONS AND AMPLIFICATIONS

In "Mainstream Lasers: Improving on Strengths" (November 23, 1993), *PC Magazine's* review of the NEC Silentwriter SuperScript 610—a 6-page-per-minute laser printer—included incorrect references to our test results. The scores reported for the five benchmark tests in PostScript mode were actually results generated in the printer's primary GDI (graphical device interface) mode. The SuperScript 610 does have a PostScript-emulator option that supports the standard 35 PostScript fonts, but it was not tested. We noted that HP PCL 4 emulation is available under Windows DOS sessions; PCL emulation, however, is also available under Windows sessions. We reported the PCL 4 results correctly. Since our review, NEC Technologies has released an updated GDI driver, which, according to NEC, improves performance on PC Labs' graphics tests by as much as 20 percent.

The February 22, 1994, New & Improved column erroneously reported the price of TAL (Timeslips Accounting Link), an optional module for Timeslips 5. The correct price for TAL is \$79.95.

An Abort, Retry, Fail? item (February 22, 1994) featuring two photographs of the same woman, each identified with a different name, did not come from the DellWare catalog, as we reported. The original source was the MicroWarehouse catalog.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016-5802, or upload it to PC MagNet (see page 12 for access information). Electronic mail may also be sent to individual editors. Type GO PCM-STAFF on ZiffNet for a list of addresses. All letters become the property of *PC Magazine* and are subject to editing.

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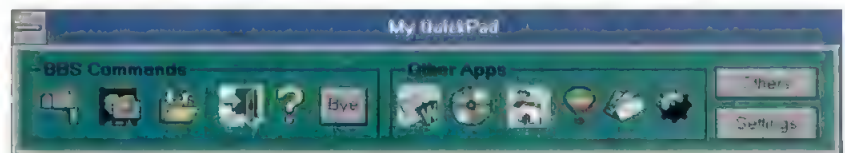
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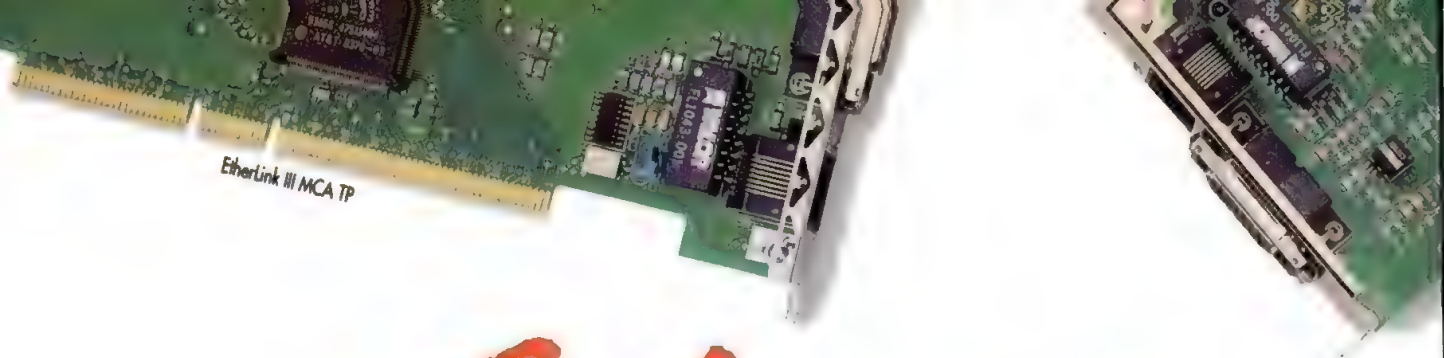
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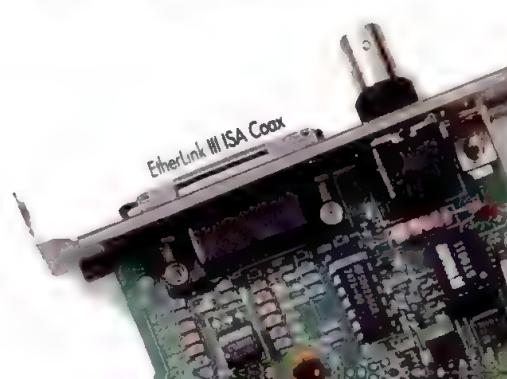
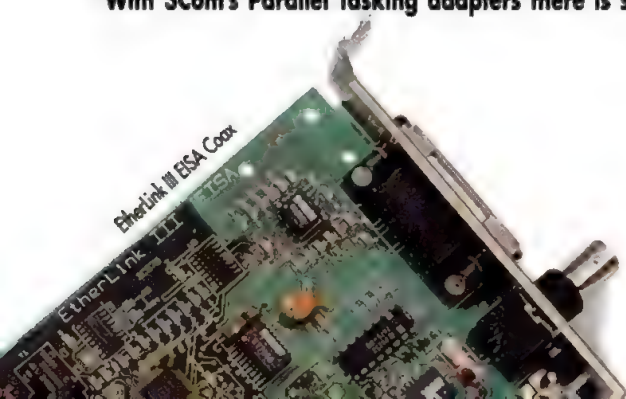
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But why not judge for yourself? For just \$99, we'll send you an EtherLink III Benchmark Kit* that includes two EtherLink III combo adapters and a *Guide to Benchmarking Network Adapters* from LANQuest Labs. Just call **1-800-NET-3Com**.

It's never been easier to put unparalleled performance on your network.



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Ami Pro and 1-2-3 are beyond compatible. They're actually congenial.

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AMI PRO AND 1-2-3 WORK TOGETHER TO HELP YOU WORK FASTER

Everyone knows Lotus® 1-2-3®, the most popular, most usable spreadsheet in the world. Now it's time you got to know Ami Pro®, the Windows™ word processor designed to complement 1-2-3.

Those who know Ami Pro, know why it wins rave reviews from industry experts time after time. Like the fact that it's consistently rated easiest word processor to use.

THEY SHARE MORE THAN LOOKS

As impressive in words as 1-2-3 is in numbers, it also has special advantages for 1-2-3 users. Because it's the only word processor designed specifically to complement and enhance your spreadsheet. Ami Pro not only looks like 1-2-3, it

behaves identically – with shared menus, common user interface, spell check, dictionary and SmartIcons.* So if you use 1-2-3, you already know how to use Ami Pro.

The integration between the two is so complete that incorporating your 1-2-3 data into an Ami Pro document is automatic and almost instantaneous.



*Call for a list of eligible word processors. Education-priced Lotus products not included. Offer valid in US only. Not to be combined with any other offer. Have your if you qualify for a competitive upgrade. In Canada call 1-800-GO-LOTUS. © 1994 Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142 and Lotus Organizer is a trademark of Lotus Development.

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The unique Collect and Copy feature lets you quickly gather any number of charts or data ranges from any number of 1-2-3 files and arrange them within a single Ami Pro document, dynamically linked through OLE and DDE. You just click on the 1-2-3 Collect and Copy SmartIcon and Ami Pro instantly takes you into your spreadsheet and guides you through the process.

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No doubt she would tell you to go right out and get the new Norton Desktop 3.0 for Windows before you damage yourself. Or your computer.

That's because NDW 3.0 not only enhances your work, it's also the safest way to run Windows short of

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Like our new Norton AntiVirus 3.0, which protects your system against over

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So the choice is yours. Either see your local dealer, call 1-800-628-4777, ext. 9114 to order, or live a life full of danger and recklessness, running Windows without Norton Desktop 3.0 for Windows and sprinting around pools with sharp objects until you finally put somebody's eye out.

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Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Virtually Inspired

Virtual reality becomes a bestseller.

High-tech has suddenly become a hot literary commodity. Databases and CD-ROM drives may be mundane material for fiction, but add them to a sizzling story with a few gigabytes of virtual reality (VR) and you have got Michael Crichton's latest novel, *Disclosure*. Chips, miniature disk drives, and proprietary software algorithms add a technical twist to the plot.

Disclosure takes place at a high-tech firm in Seattle. The plot lead the protagonist through a number of futuristic products his company is developing, including a Virtual Information Environment (VIE)—a VR machine equipped with a headset and a "walker pad." As one character describes it, "When the user walks on the pad, the projection changes, so you feel like you're walking down a corridor lined with drawers of data....The user can...open any file drawer with his hand, and thumb through the data."

Of course, the VIE is fictional, and Crichton hasn't ever seen a walk-through database. "VR is so trendy, such an overdiscussed technology," Crichton said, "that I resisted including it for a while. You don't want it to take over the book."

VR has been used in novels before, with its quintessential appearance as *cyberspace* in William Gibson's 1984 cult classic *Neuro-*

mancer. Gibson, VR's most prolific novelist, used it again in last year's *Virtual Light*. Stephen King has used VR a number of times, and one King short story was the basis of the movie *The Lawnmower Man*.

When *Disclosure* is made into a movie, will the VR passage be like *The Lawnmower Man*? "I'm against that," says Crichton. "I think of that use of VR as an arcade game. We want access to data. I invented the walker pads because I wanted walking, not flying through the data. Walking keeps VR close to the real thing."

Crichton's use of virtual reality is more than a plot device, it's a metaphor. As a character in *Disclosure* puts it, "We all live every day in virtual environments, defined by our ideas."

—Christopher Barr



VL-Bus at 2.0

WHEN INTEL'S PERIPHERAL COMPONENT interconnect (PCI) bus was announced in 1992, it was hailed by many as the heir apparent to VESA's VL-Bus standard because of PCI's asynchronous bus and multiplexed architecture. But PCI has yet to kill off the VL-Bus. Now that system makers such as ALR are beginning to implement Version 2.0, VL-Bus may have found new life.

VESA's VL-Bus developed into a way to speed graphics by offloading graphics from the slower ISA bus. Before VESA's standard was adopted, a number of proprietary local buses were developed that locked users into a few options with nonstandard connectors.

PCI is considered by many to be a superior specification to VL-Bus for a number of reasons. PCI has a 32- or 64-bit bus width, making it better suited to Pentium-class processors. It's a mezzanine bus, which means PCI is independent of the processor bus. In addition, PCI is more precise than the VL-Bus specification, which has led to incompatibilities in VL-Bus adapters. Finally, since PCI is not tied to the x86 processor, even Apple plans to ship PCI PowerMacs in 1995.

With Version 2.0, VESA VL-Bus addresses many of the limitations of its predecessor. VL-Bus is now capable of 50-MHz operation and has a 64-bit data path, up from 16- or 32-bit. Also, VESA is establishing compatibility testing and compliance procedures for adapters that will allow board makers to put a "VESA-compatible" logo on the box.

Is VL-Bus 2.0 too little too late? While there are more VL-Bus systems on the market today than PCI systems, most PC makers still plan to migrate to PCI for higher performance PCs that use Pentium-class processors. Some say the VL-Bus will be relegated to low-end 486 systems.

Some sources say that a number of processor manufacturers plan to put PCI controllers directly on the processor. Still, since VL-Bus is tied closely to the ISA bus, it may live as long as ISA does.

—Christopher Barr

Pipeline By Robin Raskin

The Age of Innocence Meets On-Line Reality

Just when the world at large was getting psyched about the possibilities of on-line exploration, the bubble burst. A great deal of the bursting took place one week in February. First, America Online announced it was too crowded to provide normal service. This gave aspiring users a clear message that on-line is not ready for prime time.

Then Prodigy responded to AOL with a news conference touting the fact that Prodigy's infrastructure—a distributed system that relies heavily on local servers talking with large IBM mainframes—is better than America Online's more centralized Stratus computer systems. With these two at each other's throats, the poor user begins to feel it's incumbent upon them to study the service's infrastructure.



Considerably more disturbing is the Internet Interlude. It started on Friday, February 4, just as I was about to head out of the office for the weekend (I often feel like the stock market by that time: Another week gone by and I haven't crashed yet). I started receiving reports about "Panic on the Internet." CERT (the Computer Emergency Response Team) had sent out an advisory urging people to change their Internet access passwords, citing concern that many (speculation is now tens of thousands) passwords had been compromised by surveillance software. The advisory came after an unprecedented number of system break-ins, many in Texas. (CERT is a govern-

ment-funded organization formed after Robert Morris, a Cornell student, unleashed a worm virus on the Internet in 1988.)

As I write this, the magnitude of the Internet events are still sketchy. Whoever these pranksters are, they've figured out a way to plant "Trojan horse" programs that appear as innocent files on the Net, but which in fact swipe and store user passwords and give them access to any private files attached to these passwords.

All of this is happening as Vice President Al Gore is stumping for technology for the masses. On Saturday, February 5, *The New York Times* ran a front page story on the government's endorsement of the Clipper chip—an encryption chip that would scramble transmitted messages but allow law enforcement officials access to data when they needed it. The government plans to use its buying power to make the chip a standard, instead of imposing the chip on industry. Naturally, an encryption technique that gives the government special access arouses suspicions in the hearts of even the most patriotic citizen.

Before we adopt global communications we need security blankets. We need to be secure in the fact that the services we contract are reliable and that our data is safe. With new services from Apple, AT&T, Microsoft, and Ziff-Davis around the corner, the issues become more urgent than ever. There are no easy answers, and on Monday as I head back to the office, the wonderful world of cyberspace has a tinge of *Mean Streets* about it.

Robin Raskin is editor of PC Magazine.

Warning: Parental Discretion Advised

VIOLENT IMAGES PORTRAYED IN the media are the target of recent attention on Capitol Hill. Because of the growing violence on television and in video games, a universal ratings system designed to warn consumers about violent, profane, and sexually explicit content could be in place in time for the next holiday shopping season.

By adopting a ratings system, the software industry would join the recording, film, and television industries in voluntarily assigning ratings or content advisories. Unlike the situation in the home video game industry, which has come under fire for controversial violence in games such as High Tech Interactive's *Mortal Kombat*, "there's been no particular ground swell aimed specifically at the PC market," says David McClure of the Software Publishers' Association. But some observers expect that the criticisms lev-

eled at sister industries will indeed affect the software industry.

The current push comes on the heels of strong social and congressional pressures calling for ratings. In February, Senators Joseph Lieberman (D-Connecticut) and Herb Kohl (D-Wisconsin) introduced the Video Game Rating Act of 1994, creating a bipartisan Interactive Entertainment Rating Commission that will work with the video game industry to develop a voluntary rating system.

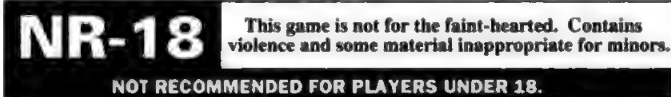
If the commission finds the industry proposal insufficient, the commission will formulate its own mandatory advisory guidelines for video games, broadly defined to include any game for computers, arcades, and home video entertainment systems.

cerns are paramount," Schwing says. "We are not censoring or banning any games.

We are trying to set up a system that protects kids and gives information to parents and consumers."

In an attempt to head off the proposed legislation, game companies Acclaim, Atari, Electronic Arts, Nintendo, Philips, Sega, and 3DO have formed the Interactive Entertainment Industry Rating System Committee to develop an industry-wide ratings system that could handle the expected 2,000 new releases a year.

Software developers have already begun to label games with consumer advisories. Megatech Software's *Metal & Lace: Battle of the Robo Babes* carries an NR-18 designation; *Mortal Kombat's* label states the game is



None of the games developed by Megatech Software has been rated by the MPAA.

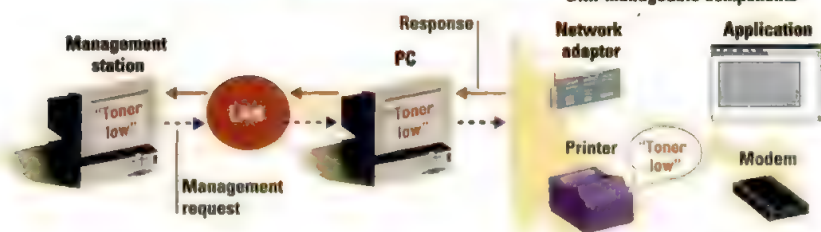
"We're trying to cover the whole spectrum," says Jamie Schwing, legal counsel for Senator Kohl. "Ultimately, though, it would be best if the industry pulled together and initiated its own ratings. First Amendment con-

PC-17; Sierra's *Leisure Suit Larry 6* declares itself MA-17 (for mature audiences only); and Virgin's *The 7th Guest* carries the disclaimer, "Parental Discretion Advised."

—Melissa J. Perenson

DMI Agents Unify the Desktop

DMI-manageable components



The Desktop Management Interface (DMI) collects desktop component information—such as a “Toner low” alert from a printer—and relays it to the LAN manager.

The Self-Aware LAN

CONTROLLING CHAOS ON THE PC is a top priority for the industry this year and developers are tackling the issue on a few different levels. At the local level, there's the Plug and Play specification, which automatically installs peripherals and resolves hardware conflicts without making you poke and prod inside your PC.

At the network level, there's the Desktop Management Interface (DMI), an intelligent agent that collects vital statistics about PCs, peripherals, and applications, and communicates the information to the network manager with the help of a network communications protocol such as SNMP (Simple Network Management Protocol). Supplied with this data, the network manager can then remotely monitor the health of all the PC components on the LAN and dispense technical support. For example, a printer agent could send an alert such as “printer out of paper” and “toner low” to the LAN manager, while a network-adaptor agent could receive setup information.

“Corporate managers have a big problem with tracking PC hardware and software because there's no management capability built into components,” says Kirsten Mortensen, of the Personal Computer Assets Management Institute. To solve this problem, DMI agents reside in PCs, and peripherals, operating systems, and applications reside in MIFs (management information files), which are ASCII files that list information such as manufacturer, serial number, driver versions, and I/O address resources.

With upwards of 80,000 PC products on the market, cooperation among developers is critical for the success of DMI. The Desktop Management Task Force (DMTF), which includes Digital, Hewlett-Packard,

IBM, Intel, Microsoft, Novell, SunConnect, and SynOptics Communications, as well as nearly 200 other hardware and software companies, has worked aggressively to implement DMI. Working groups for LAN adapters, printers, PCs, and modems are now hammering out standard MIFs for products that will ship later this year. There's also a movement to get a software group together; Microsoft and IBM are building a DMI service layer into future versions of their operating systems.

“A PC is a community of products, not one entity,” says Chris Thomas, manager of technology and alliances at Intel and chairman of DMTF. “Plug and Play and DMI work together. Once information is available to the hardware and software, there can be a much higher level of interoperability.” If Plug and Play promises a future of peaceful coexistence among PC components, DMI promises total self-awareness.

—Carol Levin

Memory Salvation At Last?

NOW THAT DEVELOPERS HAVE exhausted just about every solution for maximizing memory below 1 megabyte, the search is on to find techniques that load drivers above 1 megabyte, leaving more conventional memory to run your applications.

Two competing strategies, Helix Software's cloaking application programming interface (API) and Novell's DOS Protected Mode Services (DPMS), are getting a lot of attention.

Logitech's MouseWare 6.4, scheduled for release in April, is a good example of a program that uses Helix's cloaking technology to load itself in extended memory. The driver has just a tiny 1K footprint in conventional RAM and takes up no high memory.

Stacker 4.0, from Stac Electronics, uses Novell's DPMS API, takes up only 17K of conventional memory, and is safely loaded in protected mode. Corruption is much less likely because the driver can't be overwritten by poorly behaved programs as it can when loaded in memory.

Both cloaking and DPMS work by writing protected mode programs to a single API so that a single control program can handle resource allocation as well as manage the various descriptor tables required by the CPU when it's run in protected mode.

There's even more on the horizon. Wouldn't it be great if you could load your largest device drivers, say, CD-ROM and network drivers, in extended memory and not take any memory below 640K? You may not have to wait much longer.—Rick Ayre

Top Retail Software

Current ranking	Last issue	Product/company
1	1	MS-DOS 6.2 Upgrade Microsoft Corp.
2	2	TurboTax Final 1040 for Windows Intuit
3	—	MS Money 3.0 Microsoft Corp.
4	—	MS-DOS 6.0 Upgrade Microsoft Corp.
5	6	MS Windows 3.1 Microsoft Corp.
6	—	MS Excel 5.0 for Windows Upgrade Microsoft Corp.
7	10	WordPerfect 6.0 for DOS WordPerfect Corp.
8	3	MS Windows for Workgroups 3.11 Microsoft Corp.
9	5	MS Office 4.0 for Windows Upgrade Microsoft Corp.
10	9	OS/2 for Windows IBM Personal Software Products
11	4	Quicken 3 for Windows Intuit
12	—	Paradox 4.5 for Windows Borland International
13	—	MS Office 4.0 for Windows Microsoft Corp.
14	8	QEMM 7.0 Quarterdeck Office Systems
15	—	SuperPack 2.0 for Windows Borland International

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending February 4, 1994. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a picture of the entire software market. Sales information adapted from a compilation by Ingram Micro.

Briefs

"COPPER TOP" BATTERY CHARGES COMPAQ.

Duracell's new line of rechargeable nickel hydride batteries may be the beginning of the end for nonstandard notebook batteries. Duracell designed the batteries for notebooks as well as consumer electronics products including camcorders. If the industry adopts the standard, the batteries could be as widely available as everyday alkaline batteries.



technology or shifting platforms. Contact the Personal Computer Assets Management Institute in Rochester, New York (800-722-6487 or 716-423-0331).

CRAYOLA COMPUTER SOFTWARE TO DEBUT.

Hoping to capture a piece of the home software market, Micrografx and Hallmark subsidiary Binney & Smith (manufacturer of Crayola, Silly Putty, and Magic Marker products) have announced a venture to develop a line of software under the Crayola brand name. Crayola Amazing Art Adventure is a paint program for 3 to 6 year olds. Crayola Art Studio is for 6 to 12 year olds.—Carol Levin



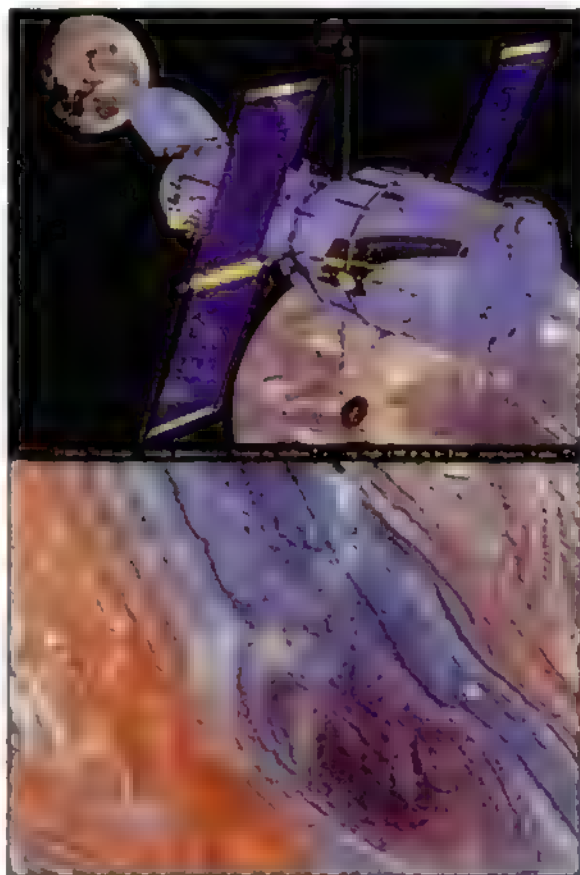
MODELING THE COST OF NEW TECHNOLOGY.

The Comprehensive Guide to Personal Assets Management (\$595) is a 250-page manual that offers corporate managers step-by-step strategies for tracking PC hardware and software—from simple identification to enterprise-wide management. The manual will help you accurately model the cost of upgrading

color technology is ink jet.)

Why not buy two separate printers? At more than \$17,000, Seiko's ColorPoint 2 is designed for high-end graphics, desktop publishing, and engineering shops. With two 300-dpi processes available in one printer, the user can inexpensively proof the output using thermal wax transfer, then print the finished work using the dye-sublimation process. You can change from one process to the other by changing the paper and the ink sheet. Although it's not as easy as it sounds, there's no need to find another printer or attach new cables; you need only one setup, one network connection, and one box sitting on your desk.

Seiko's ColorPoint 2 also comes with either a PostScript interface or a video interface. The video interface is a direct RGB connection that prints directly from the screen. Printing via the video interface is most like taking a screen shot—an expensive screen shot—using your PC's PrtSc key.—Christopher Barr



Dye sub and thermal wax in one printer.

Seeing Double, In Color

NEED A PRINTER TO OUTPUT those images of Junior you stored on Photo CD? It may be priced out of your league, but the Professional ColorPoint 2 from Seiko Instruments USA is the first color printer to offer dye-sublimation and thermal-wax-transfer technologies in the same engine.

Dye sublimation, often called thermal dye transfer, produces outstanding photorealistic pages with 24-bit true-color output by vaporizing and merging colored dyes. It's also the most costly method of desktop color printing available. Thermal wax transfer, on the other hand, doesn't produce continuous-tone images. Instead, it dithers the colors from wax-coated ribbons and provides good, reasonably-priced color output. (The least expensive

SGML Made Easy

MOST PRODUCT TRENDS APPEAR like a tidal wave that you spot miles off. The influence of SGML, though, likens more to a gradually strengthening undercurrent. By letting you define and enforce rules for the structure of documents, the Standard Generalized Markup Language (SGML) facilitates the process of updating, reorganizing, and customizing documents. Since it's a tagged ASCII format, it's also cross-platform-compatible. As such, SGML has long been used by government and industry for managing paper documentation, and is becoming more and more important to large businesses. Now the major software vendors are finally beginning to address users' SGML needs.

Traditionally, SGML tools such as Zandar Corp.'s TagWrite sprang from companies specializing in Unix-based SGML document-composition engines. Lotus, Microsoft, and WordPerfect are now entering the fray to supply SGML add-on software that integrates better with Ami Pro, Microsoft Word, and WordPerfect. WordPerfect's \$495 IntelliTag was the first of these add-ons, and it will be followed this year by Microsoft Author. These add-ons convert native format files to SGML by mapping the word processor's style tags and other formatting attributes to Document Type Definition (DTD) rules.

Transparency is key to widespread SGML adoption. SGML is powerful, but it is also difficult to learn and program, which has slowed its mainstream acceptance. Improved transparency means that you'll need to know very little about SGML formatting and structuring rules, since all of this information will be embedded in the document-creation application.

Each vendor's offerings differ in relative transparency. Microsoft Author, will separate the DTD creation from the conversion process. IntelliTag, on the other hand, works more like a traditional SGML editor, in which the end user codes the rules. Lotus will be supporting SGML with the next version of Ami Pro, but hasn't decided how far to take the implementation. Adobe plans this year to use Avalanche Development's SGML know-how to add document-structure information to the Acrobat PDF file format. And to facilitate the cross-platform portability of hypertext and hypermedia, the International Standards Organization extended SGML to create its HighTime multimedia standard.—Lori Grunin

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- Microsoft Windows for Workgroups 3.11
- Lotus Organizer

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- Microsoft Windows for Workgroups 3.11
- Lotus Organizer



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Just look what we give you: a reliable 486SX Intel processor running at 33MHz with 8K built-in cache; enough memory and power to run Windows; 4MB or 8MB RAM (expandable to 20MB); an 80MB, 120MB or 170MB IDE hard drive. And, we added local bus video for super-fast video performance. Blazing colors seem to sing. Images are vibrant and alive. For a crisp VGA backlit screen displaying up to 256 colors, the ColorNote employs dual scan technology—a breakthrough that achieves color comparable to that of a desktop color monitor yet is not as expensive as active matrix.



ZEOS dual scan screen (left) fires up rich, vibrant colors while standard passive matrix screen (right) produces faded and dull colors. Photos are not retouched.

What's more, it comes equipped with a PCMCIA slot, an internal floppy drive, built-in trackball and a Nickel-Metal Hydride battery. If your needs go beyond the standard scale, you can compose a personalized package with our many options. Let the ColorNote be the basis for your creative scores and presentations.

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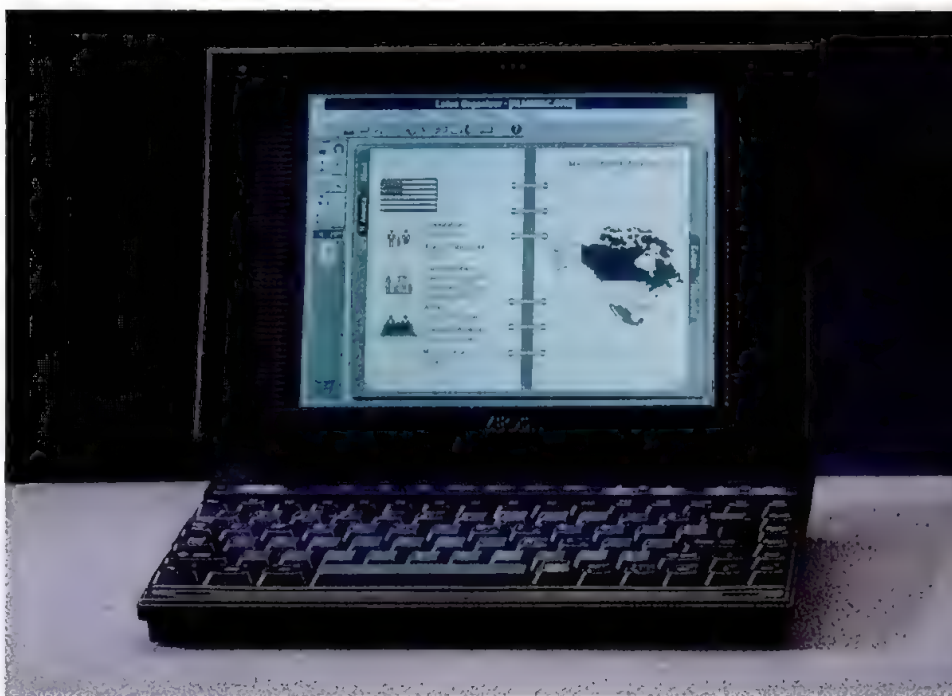
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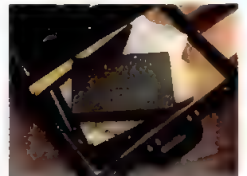
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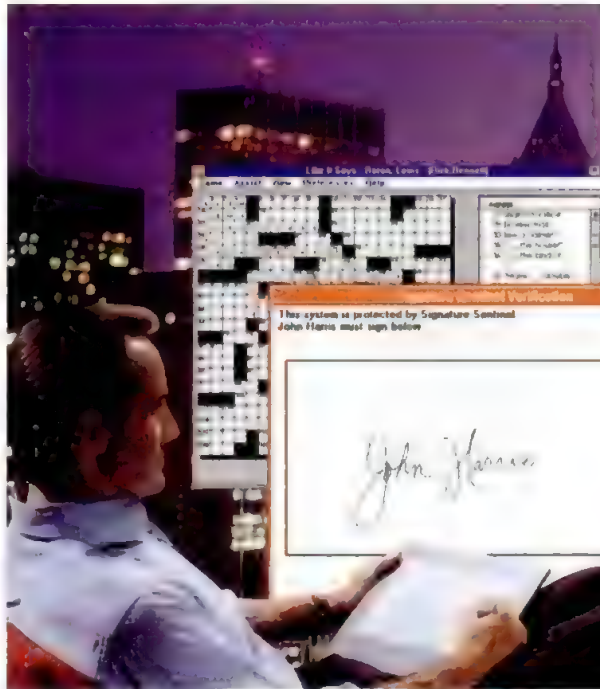
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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

■ Cover Story

\$2,500 DX4 Systems Break Exciting New Ground in 486 Price and Performance

BY TIN ALBANO AND
DON WILLMOTT

Just when you thought you knew exactly how your next PC would be configured, your buying decision has become more complicated. Get ready for some tough choices in the months to come.

The arrival of systems built around Intel's new DX4 processor will further segment the 486 marketplace, creating a niche in both performance and price a half-step below the Pentium. You will have even more choices as you shop for your next system, but you may have more confusion to confront as well. The data points on the price/performance graph are starting to crowd together.

PC Magazine Labs' first benchmark test results on four

100-MHz DX4-based systems show them to be faster overall than 66-MHz 486 machines but not as fast as 60- or 66-MHz Pentium-based machines (see the chart below). The real story here—and the good news for you—is that systems that are based on the DX4 will cost about \$2,500 when they are first released, and that pricing will help accelerate the tumbling of all 486 prices (see "More for Your Money").

Intel's master plan is to fend off CPU clone competitors by providing a CPU at virtually every level of price and performance, from entry-level systems through power-user dream machines. Whether all PC makers want (or can afford) to build so many models based on so many CPUs remains to be seen,

but the interest in DX4 technology is definitely there.

TRIPLE, NOT QUADRUPLE

The DX4 occupies the territory between the 66-MHz 486DX2 and the Pentium chip, but don't be confused by the nomenclature. Despite the fact that the chip is called the DX4, it's not twice as fast as a DX2. It's a clock-tripled chip, not a clock-quadrupled chip. Intel is offering the CPU at three speeds: 75 MHz (destined mostly for notebook PCs; see the sidebar "The Fastest Notebooks Yet" for a look at the first 75-MHz systems); 100 MHz; and, in the second half of the year, 83 MHz. The 83-MHz CPU isn't clock-tripled; it runs at 2.5 times the speed of a system's 33-MHz bus.

The chip itself is based on 0.6 micron, 3.3-volt semiconductor technology, and that means that systems built around the DX4 will have little trouble meeting Energy Star power conservation guidelines. An included 16K cache and integrated floating-point unit help to boost performance. (For more on the DX4 chip itself and how it stacks up to Pentium technology, see the sidebar "DX4: Price and Performance" in this issue's evaluation, "Unleashing the Power of the Pentium".)

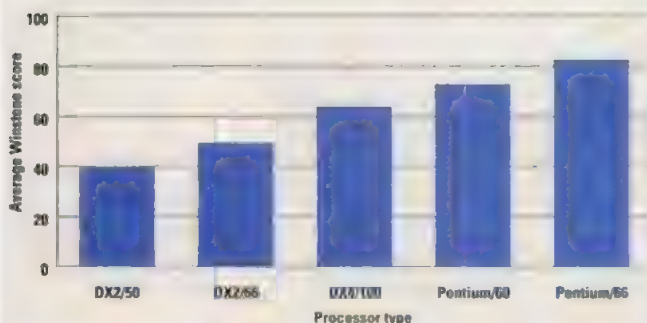


HP'S ENTRY: The Vectra VL2 4/100.

For this First Looks evaluation, PC Labs tested three DX4 systems—the Hewlett-Packard Vectra VL2 4/100, the Micron PCI 4100, and the Polywell Poly DX4-100C—to see where the processor would land on the performance spectrum. As expected, in most cases all the systems turned in results that put them squarely between 66-MHz 486DX systems and higher-end 60-MHz and 66-MHz Pentium systems. You can see how pricing is the real story.

DX4 Fills Price/Performance Gap

PC Magazine Labs' Winstone 94 benchmark test shows how systems based on Intel's new 100-MHz DX4 CPU fill a performance gap between 66-MHz 486DX2-based systems and 60-MHz Pentium-based systems.



Photography by Thom O'Connor

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DX4 Systems

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PRICE SHIFTING

It's still early in the life of the 100-MHz DX4 to predict with great accuracy what will happen to 486 PC pricing as 1994 rolls along. Nevertheless, Intel has very optimistic predictions that seem to be backed up by the prices of the first DX4 systems PC Labs has tested.

The bottom line is that soon, you'll be able to buy at least a third more performance for the same money you'd spend today, no matter how much is in your budget. The \$2,500 that would have gotten you a 66-MHz 486DX2 system from a vendor such as Gateway 2000 a few months ago will soon get you a 60-MHz Pentium-based system. You can already find such systems for \$2,799.

The same holds true for notebook PCs. High-end 50-MHz 486DX2 systems without active-matrix color displays are on sale today for around \$3,000. They should soon drop by at least \$500, while 75-MHz DX4-based notebooks take over the \$3,000 high-end position in the market.

MORE 486 POWER

The DX4 will accelerate the proliferation of 486 power, both on desktops and on the road. 486-based PCs destined for the exploding home market will be cheaper and more powerful than anyone would have predicted a year ago, and it will be easier for large corporate buyers to get the kind of horsepower they want on office desktops. The fastest notebooks PC Labs has ever tested are also arriving now. Will 60- and 66-MHz Pentium systems be frozen out by DX4 systems on one side and faster Pentium systems on the other? Time will tell, but for

More for Your Money

The arrival of DX4 systems will increase downward pressure on PC pricing. Note how much more performance the same amount of money will buy by the end of the year. At every price point, you'll find at least a 33 percent performance improvement.

Typical Desktop PCs

	Late 1993	Late 1994
\$2,500	66-MHz 486DX2	60-MHz Pentium
\$2,000	33-MHz 486DX	100-MHz DX4
<\$1,500	25-MHz 486SX	66-MHz 486DX2

Typical Notebook PCs

	Late 1993	Late 1994
\$3,000	50-MHz 486DX2	75-MHz DX4
\$2,500	33-MHz 486SX	50-MHz 486DX2
<\$2,000	25-MHz 486SX	33-MHz 486SX

now, speed demons who have been reluctant but willing to pay Pentium prices have a more affordable choice. The technology may not be as fully advanced as it is in the Pentium, but the speed is there.

HP VECTRA VL2 4/100

The newest addition to Hewlett-Packard Co.'s Vectra VL2 series of PCs is the HP Vectra VL2 4/100. Outfitted with Intel's clock-tripled 100-MHz DX4, this \$2,700 system (the price does not include a monitor)

should prove to be extremely competitive in the desktop-PC arena.

The Vectra houses Intel's DX4 chip in a standard-footprint chassis with four drive bays—two of which are accessible from the front—and four full-length expansion slots. The unit PC Labs tested had 8MB of RAM (expandable to 64MB), a 340MB IDE hard disk, a 256K cache, and a 1.44MB, 3.5-inch floppy disk drive.

For the most part, the Vectra's performance on our benchmark tests fell in line with what we were expecting from systems equipped with a 100-MHz processor. In fact, the Vectra's processor score of 62.36—slightly below typical Pentium results but well above average 486DX2/50 and 486DX2/66 results—was exactly what we thought we'd see from a DX4 machine.

The Vectra, however, turned in a low Graphics WinMark score, and its Winstone score of 31.2 was lower than the average score garnered by 486DX2/50

units. These poor scores were probably caused by the Vectra's Cirrus Logic 5428 chip set. Cirrus Logic's local-bus chip set has consistently yielded low scores on our Graphics WinMark tests but very high numbers on our DOS video tests. The system's score of 5,274.67 on our DOS video tests was among the highest we've seen.

In sum, the Vectra met our



MICRON PCI/4100: \$3,200 ready to run.

expectations, and you can see from its price tag how it and systems like it are going to force down prices of 486DX2/50- and 486DX2/66-based systems.

• List price: HP Vectra VL2 4/100, \$2,700 (without a monitor). Hewlett-Packard Co., 3000 Hanover, Palo Alto, CA 95014; 800-322-4772; fax, 800-333-1917.

Circle 432 on reader service card



Benchmark Tests: 100-MHz DX4 Systems

The processor test scores show clearly that 100-MHz DX4 systems deliver performance better than that of a 66-MHz 486DX2 but not as good as that of a typical Pentium system. Big differences in the video subsystems account for the wide diverging results from the systems we tested, especially on our DOS video tests and Winstone test.

The HP has on-board Cirrus Logic local-bus video, while the Micron system uses a fast Diamond 2MB PCI implementation based on the Weitek P9000 chip.

We used PC Magazine Labs' PC Bench 8.0, WinBench 4.0, and Winstone 94, Version 1.0 to measure the performance of the three 100-MHz DX4-based PCs.

	PC Bench 8.0				WinBench 4.0		Winstone 94
	Processor (score)	Video (score)	Disk (score)	DOSmark (score)	Graphics WinMark (millions of pixels per second)	Disk WinMark (score)	Winstone (score)
66-MHz Pentium average	78.2	1,825.2	1,414.0	834.0	20.7	1,393.3	83.0
60-MHz Pentium average	68.5	2,278.6	1,391.8	628.3	18.2	1,218.1	73.3
Micron PCI 4100 (100-MHz DX4)	64.0	1,538.4	1,378.0	754.2	20.2	1,218.1	81.7
HP Vectra VL2 4/100 (100-MHz DX4)	62.4	5,274.7	1,338.0	917.8	12.4	2,060.0	31.2
66-MHz 486DX2 average	39.8	3,359.2	1,050.3	592.7	9.5	861.4	49.7
50-MHz 486DX2 average	31.9	3,116.8	973.7	502.1	8.3	780.9	40.0

MICRON PCI4100

MAGNUM

Micron Computer's entry in the 100-MHz race, the Micron PCI4100 Magnum, not only met all of our expectations but exceeded them with ease. This PCI-based DX4 desktop has a list price of \$3,199, which makes it one of the most competitively priced DX4 systems of the three evaluated here.

What makes the Magnum's price tag so

First Looks

appealing is that you get a lot for your money: a fully loaded system with 16MB of RAM (expandable to 128MB), a 540MB IDE hard disk, a Mitsumi double-speed CD-ROM drive, a 15-inch monitor, and a generous helping of included software. The Magnum has a standard footprint chassis with four ISA and two PCI slots and one ISA/PCI expansion slot.

On our benchmark tests, the Magnum turned in performance results that easily surpassed those of 50- and 66-MHz DX2 systems. It also outshined the other 100-MHz DX4 unit tested—the HP Vectra VL24/100—on just about all of our benchmark tests. The HP earned a higher DOSmark score and a higher mark on our DOS video tests, but the Magnum's performance under DOS was certainly acceptable.

As a matter of fact, the Magnum's Graphics WinMark score of 20.2 millions of pixels per second almost matched the historical average of Graphics WinMark scores garnered by 66-

MHz Pentiums. The Magnum also came close to achieving the same kind of 66-MHz Pentium performance on our Winstone test. Its Winstone result of 81.7 was double that of the average DX2/50 system and exceeded



POLYWELL: 100-MHz in mini-tower form.

the historical performance of 60-MHz Pentiums, too. The combination of a PCI bus—with its wide data path—and a fast Diamond Viper PCI video accelerator with 2MB of VRAM helped the Magnum achieve its stellar results.

Without a doubt, the Mag-

num is a powerful PC that properly ushers in the age of 100-MHz computing.

• List price: Micron PCI4100 Magnum, \$3,199. Micron Computer Inc., 915 E. Karcher Rd., Nampa, ID 83687; 800-347-3490, 208-465-3434; fax, 208-465-3424.

Circle 431 on reader service card

POLY DX4-100C

Polywell Computers' \$3,290 Poly DX4-100C machine represents the first time that a 100-MHz DX4 has been housed in a mini-tower case.

The roomy tower has three 5.25-inch and two 3.5-inch exposed drive bays, as well as three 3.5-inch internal drive bays. There's also enough room for two 32-bit VESA/ISA and six 16-bit ISA expansion slots. As you would expect of any mini-tower unit, each one of these slots is easily accessible.

The unit we received for testing had 16MB of RAM (expandable to 128MB), a 340MB Conner IDE hard disk, a Philips double-speed CD-ROM drive, and a 15-inch monitor. The Poly DX4-100C uses a local-bus video accelerator from Diamond Computer Systems, the Viper VLB. The video subsystem is equipped with 2MB of VRAM and is built around the Weitek P9000 video chip set.

Unfortunately, because of problems with the unit's video system, PC Labs was unable to complete benchmark testing of the unit Polywell sent. Nevertheless, like the other two DX4 systems we looked at, the Poly DX4-100C is notable for the price/performance point it hits. Fully equipped for under \$3,300, it's going to give many potential Pentium buyers something to think about.

• List price: Poly DX4-100C, \$3,290. Polywell Computers Inc., 1461-1 San Mateo Ave., San Francisco, CA 94080; 415-583-7222; fax, 415-583-1974.

Circle 433 on reader service card

■ The Fastest Notebooks Yet

The heavy power consumption of the most powerful CPUs has prevented them from being built into battery-powered notebook PCs weighing less than 8 pounds, but the arrival of the power-saving 3.3-volt DX4 chip means that notebook vendors will soon be coming to market with some of the fastest battery-powered notebooks we've seen.

Intel has stated that it expects most vendors to stick with the 75-MHz DX4 chip for notebooks in the immediate future, but it's logical to assume that some notebook vendors will soon build 83-MHz and perhaps 100-MHz models as well.

NEC Technologies is one of the first vendors to add a 75-MHz notebook to its lineup. The 6.9-pound Versa E has many of the same features of other Versa E units in the line, including an excellent, optional 9.5-inch active-matrix display.

In testing, the Versa E scored 22.9 on our processor tests and had an excellent video score of 3,799.33. Pricing for the newest Versa E was not finalized at press time. For more information, contact NEC Technologies at 800-632-

8377 or 508-264-8000.

Texas Instruments has already come out with the 7.7-pound, DX4-based TI TravelMate 4000E WinDX4/75 Active-Matrix Color, the newest member of its TravelMate notebook family.

In testing, the TravelMate, with 8MB of RAM, proved fast indeed, with a good video score of 2,643.82, a strong Winstone score of 16.1, and a very good processor score of 46.15 (helped by the presence of a second-level cache). Even more interesting was its 3 hour 15-minute result on our battery test. Never before have notebook users been able to get that much computing power for that long off of one battery charge.

The price of a TravelMate with a 9.5-inch active-matrix display and a 455MB hard disk is \$5,199. The price for a system with an 8.4-inch nonactive-matrix dual-scan color display and a 340MB hard disk is \$4,599. Contact Texas Instruments at 800-527-3500 or 512-794-5970.

And there are plenty more where these came from. The 75-MHz notebooks from NEC Technologies and Texas Instruments are just the first of what we expect will be a flood of 75-MHz notebook models, due to hit store shelves by the summer. —DW



TI TRAVELMATE: A fully loaded model costs \$4,599.



75-MHz ON THE ROAD: NEC's Versa is under 7 pounds.

■ Operating Systems

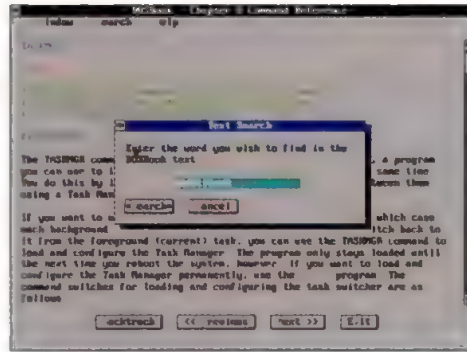
And Novell Makes Three: Is This the Right DOS for You?

BY EDWARD MENDELSON

Novell DOS 7 is the most significant advance in DOS technology in years, and it's the first DOS designed to feel at home in the networking era.

You don't need a network to benefit from the improvements Novell's \$99 operating system brings to DOS-based memory management, disk compression, security, and task-switching. But Novell DOS includes all the software you need to set up a workstation as a client for a NetWare network and includes the complete software needed for setting up a Personal NetWare peer-to-peer network. (For details on Novell DOS networking, see "DOS 7's Built-In Networking").

Compared with MS-DOS 6.2 and IBM DOS 6.1, Novell DOS



DOS BOOK: Novell DOS 7 includes hypertext on-line documentation.

(which grew out of Digital Research's DR DOS) gives you more usable memory, a more flexible and powerful set of basic commands and file-management utilities, a full implementation of the best disk compression software (Stacker, Version 3.1—

not the just-released 4.0), and effective password protection for files, directories, and your complete system.

MS-DOS and IBM's PC-DOS are based on the same programming code. Although Novell DOS is highly compatible with its Microsoft and

IBM counterparts and uses almost identical commands, its program code was newly written by Novell.

THE DPMS DIFFERENCE

Novell DOS 7 introduces a new memory-management feature

named DOS Protected Mode Services (DPMS). It's comparable to the older Expanded Memory Specification (EMS) in allowing drivers and terminate-and-stay-resident programs to load much of their code above the first megabyte of memory. But unlike EMS, DPMS doesn't eat up 64K of memory for a page frame.

DPMS lets the network software, disk cache, CD-ROM extensions, and Stacker disk compression drastically reduce their footprint in the first megabyte of RAM. Stacker, for example, uses 16K of upper memory, compared with 39K for MS-DOS's DoubleSpace. Novell's cache typically needs 8K less RAM than Microsoft's SmartDrive, and its CD-ROM extensions need 7K instead of Microsoft's 16K. Expect third-party communications drivers and similar software to support DPMS soon. Novell DOS also frees memory by loading SHARE and other DOS-related code into the high-memory area. Novell DOS comes with

Continued on page 42

■ DOS 7's Built-In Networking

It's difficult to pin the right label on Personal NetWare.

- It's networking software;
- it's an OS utility that ships as part of Novell DOS 7;
- it's a standalone product that works with Microsoft DOS or IBM's DOS.

by Frank J. Derfler, Jr.

First and foremost, Personal NetWare is a peer-to-peer network operating system. Any PC can act as a file or print server across the LAN, but it's also a smooth ramp to the dedicated server versions of NetWare and, in fact, ships as the client software in the NetWare 4.01 package. You can call Personal NetWare the successor to NetWare Lite, but it has almost nothing in common with that earlier package.

Personal NetWare has first-class features. Any PC can

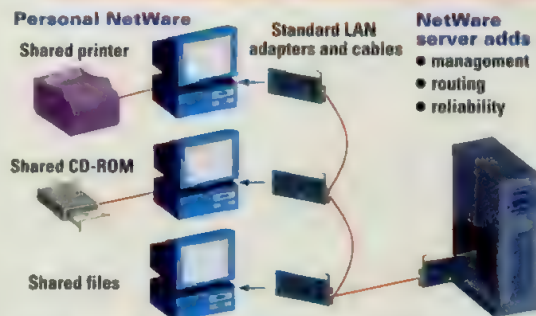
share its files, CD-ROM drives, and printers across a network, and the software works over practically any brand of Ethernet, Token-Ring, or ARCnet networking hardware. The design of the software allows anyone designated as a member of a workgroup to log on only once

to gain access to all servers. This is very different from the server-by-server log ons needed for most peer LAN systems. The use of SNMP network management also differentiates Personal NetWare from peer-to-peer competitors such as LANtastic and Microsoft Windows for Workgroups.

Personal NetWare does not have the half-finished feel

of NetWare Lite. It's fully integrated and interoperable. The Personal NetWare server module (SERVER.EXE) runs under DPMS, and Novell's DOS 7 puts all but about 40K in high memory. The client software hides completely in extended memory, while other modules, such as those used to link to a NetWare 2.x server load as needed. Personal NetWare has excellent interfaces for both Windows and DOS. You can get Personal NetWare as a standalone product for \$99 (a five-user version is \$395). Users of NetWare Lite can upgrade for \$39.95.

How Personal NetWare Works



Adding a NetWare 3.x or 4.x server to a Personal NetWare network lets you expand the LAN with full NetWare services.

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With OmniScan, you can send, receive, OCR, and compress faxes right from your computer using Caere's FaxMaster technology. All you need is a fax modem. OmniScan does the rest.



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Image Assistant GS makes grayscale image editing and enhancement a snap. The "Assist Mode" displays sample image variations right on your computer screen. All you have to do is choose the one that works best for you. And to help you add your own personal touch to images, Image Assistant GS features a complete set of editing tools and features.



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CIRCLE 097 ON READER SERVICE CARD

For Your Information.

Novell DOS 7

CONTINUED FROM PAGE 40

memory managers for 286- and 386-based systems or better, but it also works with third-party memory managers like QEMM and 386MAX. Advanced QEMM features like Stealth work perfectly with DOS 7, although you'll have to wait for a fix from Quarterdeck before you can use QEMM's DOS-UP and DOSDATA features.

A multitasking utility included with DOS 7 lets you download files or sort a database in the background while using a word processor in the foreground. It even lets you switch in and out of standard-mode Windows, but not Windows running in Enhanced mode. You can adjust background/foreground priority, as with DESQview's similar multitasking feature. The multitasker requires Novell's built-in memory manager. If you use a third-party manager instead, the program provides only task-switching, with background tasks suspended when you switch away from them.

LITTLE THINGS MEAN A LOT

Small refinements are everywhere. The DISKCOPY command can create an image of a disk as a file, so you can copy it to another disk later. Batch files include subroutines, and special system variables make complex batch-programming possible. You can configure the DOS prompt to run a specified program every time the prompt reappears. A password-protected DOS and Windows screen saver comes in the package. File-management commands can use file lists stored on-disk as well as standard wildcards.

The add-on utilities for backup, disk defragmenting, and

antivirus work about as well as those in MS-DOS, but they're no match for the superior utilities in IBM's PC-DOS. Novell's reduced version of Fastback Plus backs up only to floppies or to DOS paths, while IBM has the full Central Point Backup, which works with high-capacity tape drives.

NOT TOTALLY COMPATIBLE

Novell DOS's compatibility with the DOS versions from Microsoft and IBM is almost perfect, but not quite. On one test system, shareware utilities that extend the DOS path beyond 127 characters made the path unusable, and some command-line editing programs won't work in Windows DOS boxes.

More unsettling is a problem with Windows for Workgroups 3.11, which includes a VSHARE 386 driver that performs the functions of DOS's SHARE.EXE. When this version of Windows runs under Novell DOS, applications that need SHARE's function complain that SHARE isn't loaded, and you have to exit Windows and run Novell DOS's SHARE.EXE. Fortunately, this loads in high memory, but you shouldn't have to load it at all.

The installation, unlike Microsoft's and IBM's, respects your existing setup and won't clobber third-party memory managers. Almost all features of the operating system can be configured from full-screen menus, and a hypertext help system provides further details.

If you have a standalone PC packed with third-party utilities like the Norton Cache or Corel's CD-ROM extensions, and you don't use disk compression, you won't gain much by switching to Novell DOS from MS-DOS 6.2. For unsophisticated users, the DOS 6.2 feature that defaults to asking for confirmation when overwriting files is a crucial safe-

ty feature not built into Novell DOS. But if you use networking and you need security, if you want Stacker's superior compression speed and flexibility, or if you simply want the most advanced DOS on the market, Novell DOS is the one that you

want on your machine.

•List price: *Novell DOS 7*, \$99. Requires: 640K RAM, 6MB to 12MB hard disk space. Novell Inc., 122 East 1700 South, Provo, UT 84606; 800-4531267, 801-429-3098.

Circle 428 on reader service card

Video

ATI Graphics Wonder Is a \$199 Dazzler

BY BEN MYERS

The \$199 ATI Graphics Wonder graphics adapter, available in both ISA and VL-Bus versions, represents a breakthrough combination of features and performance at this price level.

The Graphics Wonder has a clean, simple design built around ATI's own Mach 32 graphics chip and an included 1MB of DRAM memory. That's enough power for 16.7 million colors at 640-by-480 resolution, 65,536 colors at 800-by-600, 256 colors at 1,024-by-768, or 16 colors at 1,280-by-1,024.

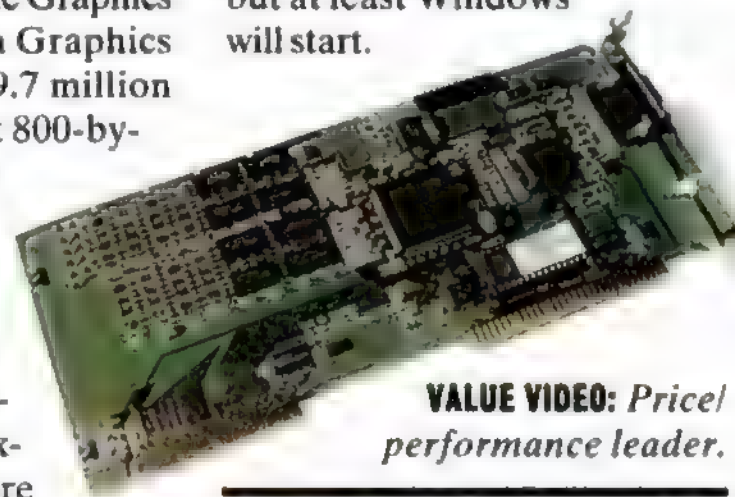
On PC Magazine Labs' WinBench 4.0 test, the Graphics Wonder produced a Graphics WinMark score of 9.7 million pixels per second at 800-by-600 resolution with 256 colors on a 486DX2/66 VL-Bus system. When tested with 16.7 million colors at a resolution of 640 by 480 pixels, its WinMark score was 1.64 million. Both results are very good for a board at this price point.

The software included with the Graphics Wonder is as interesting as its good performance. ATI's FlexDesk utility lets you change resolution, font size, and number of colors displayed on-screen; and you can adjust brightness, contrast, hue, and saturation levels for optimal viewing.

We found one small wrinkle while installing the Graphics Wonder. If you switch to different but compatible drivers, the

ATI software creates a modified copy of the Windows program, WIN.COM. This works with Windows 3.1 but may not with other Windows variants such as Windows for Workgroups. With these releases, the WIN command is rendered useless.

Until ATI has a software correction available, there's a simple solution. Before running the install software, create a backup copy of WIN.COM. After installing the Graphics Wonder drivers, copy your original WIN.COM over the version created by the ATI installation software. You won't see the ATI logo when Windows starts up, but at least Windows will start.



VALUE VIDEO: Price/performance leader.

In the fast-changing world of video, it's hard to make definitive statements that are valid for more than a few months, but for now, you'd be hard pressed to find a video board under \$200 with a better combination of features and performance than the Graphics Wonder.

•List price: *ATI Graphics Wonder*, \$199. ATI Technologies Inc., 33 Commerce Valley Dr., East Thornhill, Ontario, Canada, L3T 7N6; 905-882-2600, ext. 1; fax, 905-882-2620.

Circle 430 on reader service card



From March 28 through April 1, you can go on-line to discuss Novell's DOS 7 with Edward Mendelson; Tobey Corey, Novell's director of marketing, Desktop Division; and John Linney, product manager for DOS 7. Type GO EXEC from any CompuServe! prompt.

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Supra Corporation

PRODUCT	PC	DESCRIPTION
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SupraFAXModem PLUS	\$139.95	External 2400 bps data & 9600 bps fax
SupraFAXModem 144i	\$149.95	Internal 14,400 bps data & fax
SupraFAXModem 144LC	\$169.95	External, low-cost 14,400 bps data & fax

PRODUCT	PC	DESCRIPTION
SupraFAXModem V.32bis	\$229.95	External 14,400 bps data & fax with display
SupraCOMcard 144	\$349.95	PCMCIA 14,400 bps data & fax
SupraFAXModem 288i	\$349.95	Top-of-the-line, internal 28,800 bps data & 14,400 bps fax
SupraFAXModem 288	\$399.95	Top-of-the-line, external 28,800 bps data & 14,400 bps fax

Digital Photography

Forget Film! Apple's QuickTake Saves to Disk

BY RICH SANTALES

At \$749, Apple's QuickTake 100 hits a new price/performance peak for true 24-bit color digital cameras. With its nearest-priced competitor, the Logitech Fotoman Plus, being a black-and-white camera, and its nearest color competitor, the Dycam Model 4, costing twice as much, the QuickTake is certain to attract attention.

Apple's QuickTake weighs just over 1 pound and measures 2.2 by 5 by 6 inches (HWD). It can take 32 8-bit pictures at 320-by-240 resolution, 8 24-bit pictures at 640-by-480 resolution, or a mix of pictures at either low or high resolution. The

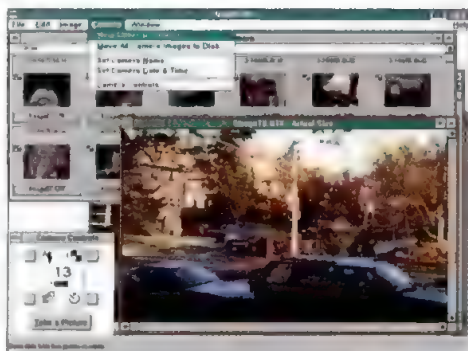
QuickTake uses a new Kodak CCD (Charge-Coupled Device) that has a patented Bayer filter array pattern to maximize sharpness and color balance. Designed as an offshoot of Kodak's \$8,000 professional digital color DCS 200 camera, the QuickTake's CCD grabs 307,200 pixels per frame. While this falls far short of the 1.5 million pixels snapped up by the DCS 200 or the breathtaking 4 million pixels snagged by the \$36,000 Leaf Digital Camera Back, but it beats both the Fotoman's 180,000- and the Dycam's 200,000-pixel resolutions.

FULLY AUTOMATIC

Like the Fotoman and Dycam, the QuickTake is a point-and-

shoot camera. With the equivalent of a 50-mm lens and apertures ranging from f/2.8 to f/16, the QuickTake can focus from 4 feet to infinity using shutter speeds between 1/30 and 1/175 of a second.

The QuickTake's controls are well designed and fit naturally to the hand's contours. A serial port and an AC connector reside beneath a recessed sliding



TRUE COLOR: QuickTake software allows for color depth switching.

panel on the camera's left side. To the right of the viewfinder, a small LCD control panel provides feedback on battery life and the number of pictures taken and remaining (which changes if the resolution is switched). Control buttons next to LCD indicator

icons set the current resolution, activate the self-timer, toggle the flash between automatic, manual, or backfill, and turn the camera on or off. There is also a button that deletes stored pictures. All of the controls are basi-



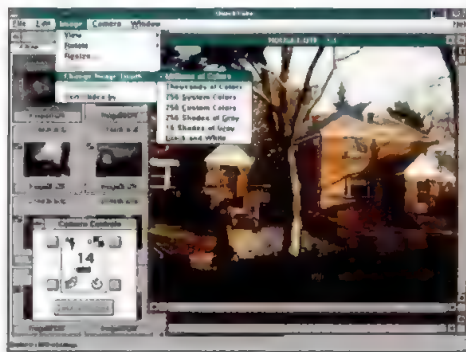
ONE-HANDED:

The QuickTake 100 is very easy to handle.

cally self-explanatory and easy to use.

The difference in perceived image quality between images at 320-by-240 resolution and images at 640-by-480 resolution is stunning. At the higher resolution, pictures display virtually none of the pixellation that is evident in smaller images and appear more evenly balanced in color and contrast as well. But at both resolutions, color saturation and accurate rendering of balanced-contrast scenes is uniformly excellent.

Unlike Logitech's practice of storing pictures in volatile RAM, the QuickTake saves images in Flash EPROM, ensuring that the end of battery life does not mean the loss of your digital memories. According to Apple, images stored in the QuickTake last up to a year before fading. In testing, we left the camera on overnight, without batteries, and our images remained intact—though the camera's clock required resetting the next day.



SLIDE TABLE: QuickTake software presents thumbnail previews of all stored images.

FORGET FILM

The only thing you load in the QuickTake is three AA batteries; a set of nickel cadmium batteries and a wall-plug recharger are included with the camera, along with a neckstrap, serial cable, and software (for either the Mac or Windows) for downloading, viewing, and organizing images. Offices with both Macintoshes and PCs will be able to purchase the other platform's software and cable separately, enabling smooth cross-platform usage.

Apple's QuickTake software is a simple downloading package centered around a slide table metaphor. It has image viewing, cropping, rotating, resizing, and color depth switching from native 24-bit color to 16-bit or 8-bit color (using either a custom or system palette), 8-bit or 4-bit gray scale, and 1-bit black-and-white images. For serious image retouching and color manipulation Apple rightly expects users to rely on other tools.

In keeping with its cross-platform roots, the software saves images in .BMP, .GIF, JPEG, .PCX, TIFF, and QuickTake's native PICT format. We found JPEG high-quality images to be virtually indistinguishable on-screen from native images, while requiring only one-third the disk space.

The QuickTake is certain to find eager users in desktop publishing, image database, and other applications where color scanning or imaging has been either inconvenient or impossible. With the arrival later this year of additional digital cameras from Logitech, Polaroid, Sony, and possibly others, true-color digital photography has finally become not only affordable but truly practical as well.

• List price: *QuickTake 100*, \$749. Requires: 4MB RAM, 7MB hard disk space, Microsoft Windows 3.1. Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014; 800-538-9696, 408-996-1010.

Circle 403 on reader service card

AREAS OF DOMINANT INFLUENCE



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- 800x600NI, 640x480@72Hz
- Energy Star (EPA) Compliance



MicroScan 3E

- 14-inch (13.5V) 0.28dp
- 1024x768NI, 800x600@72Hz
- Swedish MPRII (optional)
- Energy Star (EPA) Compliance



MicroScan 3GP

- 14-inch (13.5V) 0.28dp
- 1280x1024NI, 1024x768@76Hz
- WYSWYG Color Matching
- Swedish MPRII
- Energy Star (EPA) Compliance and Nutek/TCO Compliance



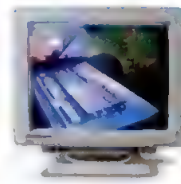
MicroScan 4GP

- 15-inch (13.8V) FST 0.28dp
- 1280x1024NI, 1024x768@76Hz
- WYSWYG Color Matching
- Swedish MPRII
- Energy Star (EPA) Compliance and Nutek/TCO Compliance



MicroScan 5EP

- 17-inch (15.8V) FST 0.28dp
- 1280x1024NI, 1024x768@76Hz
- WYSWYG Color Matching
- Swedish MPRII
- Energy Star (EPA) Compliance and Nutek/TCO Compliance



MicroScan 5AP

- 17-inch (15.8V) FST 0.26dp
- 1280x1024NI, 1024x768@76Hz
- WYSWYG Color Matching
- Swedish MPRII
- Energy Star (EPA) Compliance and Nutek/TCO Compliance



March 16, 1993
ADI MicroScan 3E+



- ★★★★ 8.0 ADI MicroScan 4GP
- ★★★ 7.7 MAG MX 15F
- ★★★ 7.5 Viewsonic 15
- ★★★ 7.5 CTX CPS 1560LR
- ★★★ 7.2 NEC 4FGc



Here's why ADI Monitors are Dominant



Microprocessor Intelligence

Analyses and remembers size, centering, and geometrical adjustments for the different video modes you work with.



Fingertip Front Panel Controls

Can be used to individually adjust and customize each display mode for display size, centering, and geometrical distortions.



Controls Pincushion and Barrel Distortions

Pincushioning alters the shape of on-screen images, making them appear concave. Barrel distortion is the inverse of pincushioning. Instead of curving in, the on-screen image bows out, resembling a barrel.



Vertical Linearity

If the horizontal bars appear to be crowded at the top or the bottom (using Windows Excel), the vertical linearity control may be used to correct such symptoms.



Vertical S-Correction

If the horizontal bars appear to be crowded near the center but are of equal spacing at the top and bottom, the vertical S-correction control may be used to adjust such symptoms.



WYSWYG Color Matching

Allows you to work with colors you expect to see in your finished print-out.



Non-interlaced Image Scanning

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Byte Magazine, Jan. 1994

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CIRCLE 226 ON READER SERVICE CARD

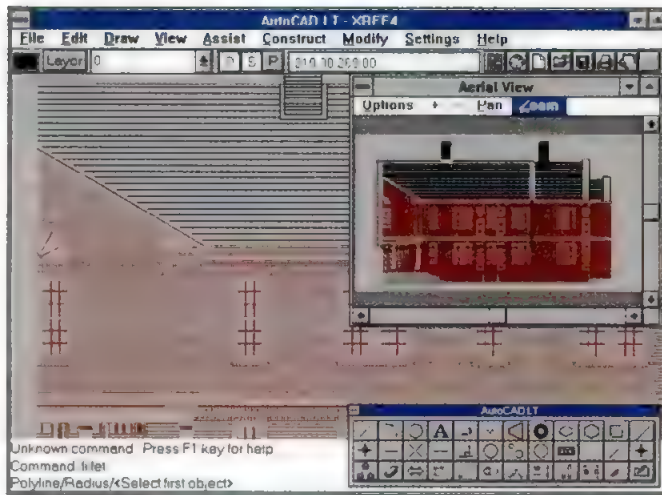
■ CAD

AutoCAD LT: A \$495 Peek at High-end CAD

BY MARK BROWNSTEIN

Never before has a program with AutoCAD in its name been priced this low. At \$495, Autodesk's AutoCAD LT stakes out new territory between drawing programs and overwhelming high-end CAD programs. It's a comfortable fit for casual, part-time CAD users who work alongside AutoCAD experts or for anyone looking for full 2-D and basic 3-D CAD in Windows.

AutoCAD LT, a spinoff of AutoCAD, Release 12, fits into Autodesk's expanding product line somewhere above AutoSketch and the DOS-based



CLOSE RELATION: AutoCAD LT looks a lot like regular AutoCAD.

Generic CADD but definitely below AutoCAD. The program includes much of the \$3,750 AutoCAD's 2-D design capability but only some limited 3-D tools.

Drawings you create with AutoCAD LT (in the .DWG format) can be read and edited directly in AutoCAD, Release 12; conversely, you can view and edit AutoCAD drawings in AutoCAD LT, although links to AutoCAD enhancement programs and three-dimensional effects that AutoCAD LT doesn't support can be lost if you change them.

There's no doubt that AutoCAD LT is powerful. Its support of exact dimensions lets you create accurately scaled drawings. The program can handle office plans, architecture, mechanical design, electronic parts layout, and other design tasks.

The toolbox, which includes most of the drawing tools, is a pleasure to use. Move the arrow over the tool icons and the process that each icon represents is written at the top.

For users who are new to CAD, AutoCAD LT will take some time to learn. Fortunately, it comes with all-new documentation that is far less intimidating than the several volumes that come with AutoCAD.

AutoCAD LT can become a home drafting package for people who use AutoCAD at work and just need to view or make minor changes to drawings. You might even want to use it as a relatively low-cost introduction to AutoCAD. If it works well enough for you, you won't have to buy AutoCAD, and you'll save over \$3,200.

• List price: AutoCAD LT, \$495; upgrade for Generic CADD users, \$199. Requires: 4MB RAM (8MB recommended), 10MB hard disk space, permanent swap file two to four times the size of RAM, Microsoft Windows 3.1. Autodesk Inc., 2320 Marinship Way, Sausalito, CA 94965; 800-964-6432, 415-332-2344.

Circle 401 on reader service card

■ PCMCIA

New Bus Toaster Pops Up SCSI for Notebooks

BY SHERYL CANTER

If you thought you needed a docking station to attach SCSI devices like CD-ROM drives to your notebook PC, think again. If your notebook has a standard Type I PCMCIA slot, then all you need is New Media Corp.'s \$359 Bus Toaster. A high-speed SCSI-2 adapter with performance comparable to that of a desktop ISA-to-SCSI adapter, the Bus Toaster lets you attach up to seven external SCSI devices such as CD-ROM drives, hard disks, and tape drives. Bundled with it is CorelSCSI, which provides a multitude of SCSI device drivers and utilities.

For the most part, installation is straightforward, but we did encounter one glitch. The port assignment for the Bus Toaster, which is assigned automatically by the installation software, was invalid on our test machine and overwrote system memory. Once we identified the source of the problem, we changed the port address with a

simple command switch and the problem went away.

Problems such as these are a symptom of the nonstandardness of the PCMCIA standard. The Bus Toaster uses PCMCIA Card and Socket Services to request hardware resources. Since not all manufacturers ship an implementation of this specification with their machines, New Media includes CardSoft, from SystemSoft Corp., with the Bus Toaster.

Our test machine, IBM's ThinkPad 720C, comes with its own card and socket services, so we didn't need CardSoft. Apparently, IBM's interpretation of the spec differs from SystemSoft's, so the driver's technique for requesting a port failed.

After installing the software, you don't need to keep the Bus Toaster in the slot at all times.

When you attempt to access a SCSI peripheral, the driver looks for the card and will prompt you to insert it if it's not there. Best of all, you don't have to power-down your notebook before inserting or removing the card: It's hot-swappable.

Despite its impressive speed, the Bus Toaster draws less power than the maximum proposed by the PCMCIA standard, and the driver is smart enough to turn off parts of the card not in use, which also helps



ADAPT:

Attach up to seven devices.

extend battery life. The Bus Toaster is an excellently engineered combination of hardware and software.

• List price: Bus Toaster, \$359. Requires: Type I PCMCIA slot. New Media Corp., 15375 Barranca Pkwy., Bldg. B101, Irvine, CA 92718; 800-453-0550, 714-453-0100; fax, 714-453-0114.

Circle 402 on reader service card

■ Data Compression

Stacker 4.0 Squeezes Even More Data Onto Your Disk

BY CHRISTOPHER BARR

Disk compression, the sleight-of-hand that lets you squeeze more files onto a disk than it has room for, seems especially magical with Stacker 4.0. Stac Electronics has developed a new technology called SmartPack that wrings even more space out of an existing disk than either Microsoft's DoubleSpace or earlier versions of Stacker.

Stacker 4.0 also uses a new memory technology called DOS Protected Mode Services (DPMS), developed by Novell, to load most of the compression driver into 386 protected-mode memory. Using a 2K DPMS driver, the Stacker 4.0 driver is reduced to from 44K to 17K and can load high.

IMPRESSIVE GAINS

Stacker 4.0 claims a 50 percent increase over the typical 2:1 ratio that disk compression utilities can usually achieve. Last year, when PC Magazine Labs tested all compression products (including Stacker 3.1 and DoubleSpace), the average hard disk achieved a compression ratio of 1.8:1. If Stacker 4.0 could reach 2.5:1 or beyond, it would mean megabytes of extra disk space.

We achieved impressive gains using Stacker 4.0, and although we never approached the 2.5:1 claim, it's important to note the relative increase in compression we did achieve.

We tested Stacker 4.0 on a 486/33 system equipped with a 210MB hard disk, DOS 6.2, and Windows for Workgroups 3.11. The version of DoubleSpace that came with DOS 6.2 compressed the entire disk at a 1.6:1 ratio. We installed Stacker 4.0 on the drive, converted the DoubleSpace volume, and achieved a compression ratio of

already compressed.

On tests run on three different systems, Stacker 4.0 consistently added over 30 percent more space to the hard disks. One hard disk that had been compressed by the older Stacker 3.1 to a ratio of 1.7:1 was further squeezed to 2.1:1. A hard disk on a notebook with 10MB free suddenly had 35MB free when the compression ratio jumped from 1.8:1 to 2.1:1.

Exactly how much extra space you'll gain by using Stacker 4.0 is very much dependent on the type of data residing on your disk. Real-time lossless disk com-

pression programs like Stacker reduce file size by condensing redundant bits of information. When we ran our tests, database, spreadsheet, text, and word processing document files compressed to less than a third of their original sizes. Program files (.EXE, .COM) had less room to compress and averaged 1.9:1. Previously compressed files, such as .ZIP files, can actually get larger if you try to squeeze them, so Stacker's compression algorithm is smart enough to leave them alone.

CAVEATS TO CONSIDER

Stacker 4.0 doesn't support Windows for Workgroups' 32-bit file access, which means it may run slower on some machines that use Windows for Workgroups 3.11 and have 32-bit file access enabled.

On a Windows for Workgroups system, we compared a volume compressed by DoubleSpace running 32-bit file access to the same volume recompressed by Stacker 4.0 running without 32-bit file access. While we made a

gain in the compression ratio, the Stacker 4.0 volume suffered a big loss in disk performance under WinBench 4.0's Disk test.

Because Stacker 4.0 uses a new file format, you may experience incompatibilities with utility packages such as Symantec's The Norton Utilities or Central Point's PC Tools. Since they don't recognize the new file formats, programs such as Norton's Speedisk and Disk Doctor display error messages recommending you to use the disk performance tools that come with Stacker 4.0. DOS 6.2's ScanDisk utility, which didn't recognize the Stacker 3.1 format, doesn't recognize the Stacker 4.0 format either.

Stac Electronics is aware of the performance differences under Windows for Workgroups and is working to address them. And since Stac has worked closely with Symantec and Central Point in the past, both companies are expected to support Stacker 4.0 in the future.

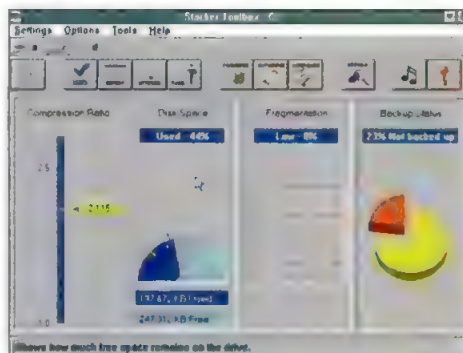
Stacker 4.0 comes with a number of performance and safety utilities that are accessible under either DOS or Windows. New in Stacker 4.0 is a Windows Toolbox that lets you monitor, adjust, optimize, and reconfigure your compressed volume. There are a number of new protective features to ensure that the compressed volume doesn't become corrupted.

Despite some of Stacker's early inconsistencies, the compression results you can achieve with Stacker 4.0 are impressive. •List price: Stacker 4.0 for Windows and DOS, \$149; upgrade, \$49.95. Requires: 17K RAM, DOS 3.2 or later, Microsoft Windows 3.1. Stac Electronics Inc., 5993 Avenida Encinas, Carlsbad, CA 92008; 800-522-7822, 619-431-7474; fax, 619-431-0880.

Circle 427 on reader service card



From April 4 through April 8 you can go on-line to discuss Stacker 4.0 with Christopher Barr and Stac Electronics' VP of marketing, John Bromhead, and product manager Anne Galdos. Type GO EXEC from any CompuServe prompt.



SQUEEZE PLAY: More tools have been added to help you monitor your disk.

The screenshot shows the 'Stacker Report - All Files From Drive C:' window. It contains a table with columns: 'File', 'Type', 'Size', 'Count', 'Bytes', 'Comp Ratio', and 'Comp Ratio'. Below the table are 'Sort Order' options (Ascending, Descending) and a 'Summary' section showing 'Total Directories: 143' and 'Total Files: 3,122'. There are 'OK', 'Help', and 'Print' buttons at the bottom.

File	Type	Size	Count	Bytes	Comp Ratio	Comp Ratio
data	...	...	...	46,674,266	...	...
data	...	...	...	28,627,453	...	...
data	...	...	...	24,139,507	...	...
data	...	...	...	7,017,556	...	...
data	...	...	...	4,629,674	...	...
data	...	...	...	2,489,721	...	...
data	...	...	...	2,478,544	...	...
data	...	...	...	2,334,840	...	...
data	...	...	...	2,282,048	...	...
data	...	...	...	2,279,137	...	...

HOW TIGHT? The compression ratio report is accessible under both DOS and Windows.

2.1:1. While the difference between 1.6 and 2.1 seems small, in reality it's not. Every 0.1 compression ratio improvement represents 10MB of disk space, so Stacker 4.0 created an extra 100MB on a disk that was

Printers

HP's New DeskJets: Evolutionary Steps in the Right Direction

BY ALFRED POOR

According to statistics from Hewlett-Packard Co., the DeskJet printer line owns more than half the ink jet market and more than 80 percent of the color ink jet market. A lot of that success can be attributed to two DeskJet models: the black-and-white 500 and the color 550C. Now HP has replaced them with two improved models—the HP DeskJet 520 and HP DeskJet 560C.

You won't pay more for the printers' new capabilities. In typical HP fashion, the new printers do more than the units they replace but come at the same price. The DeskJet 520 carries a list price of \$365; the DeskJet 560C, \$719.

The new models include a number of important features, most of which are evolutionary rather than revolutionary. Still, the combination of improvements results in visibly better output quality.

SHARING NEW FEATURES

Both printers share a number of these new features. For example, the DeskJet printhead has always had the ability to print images at 600- by 300-dpi resolution (and, in fact, prints resident fonts at this resolution for DOS applications), but it has supported graphics only in resolutions up to 300 by 300 dpi. The new printers can print at 600 by 300 dpi when printing black and white in either Normal or Presentation mode. Presentation mode is

another new feature; it prints more slowly than Normal mode but produces higher-quality output in which graphics images undergo almost no banding.

Both printers also support EconoMode, in which the output is printed at 150- by 300-dpi resolution, saving both time and ink. And while both printers use the same black ink cartridge as the other DeskJet printers, the ink has been reformulated to provide faster drying and more resistance to smudging.

Some of the most noticeable changes appear under Windows in HP's new printer driver for the entire DeskJet line. The package includes TrueType fonts from 11 different typefaces (plus bold and italic for some of them). There's an improved diffusion pattern for printing halftone images (such as photographs), and you get the full 600-by-300 resolution for Windows text and graphics output. Best of all is the improved user interface for choosing printer driver options: You simply pick the features you want from a menu of icons.

The quality of the black-and-white output is excellent, especially under Windows. There's remarkably little wicking of the ink when printing text, even on inexpensive photocopier paper,

It uses the same black ink cartridge as the DeskJet 520 but adds a separate three-color cartridge (cyan, yellow, and magenta), so you get rich colors as well as solid blacks.

The improved Windows driver has an extra feature for the DeskJet 560C: ColorSmart, which analyzes each page as it is printed and then adjusts the printer settings to get the best color quality. That would be impressive in itself, but ColorSmart goes beyond simply analyzing the page as a whole: It identifies each area of the page that uses color and then adjusts

the settings for that area.

As a result, a scanned photographic image is printed using a diffusion



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OUTPUT SAMPLES: The DeskJet 520 handles text (lower right) and halftone images (lower left) well. The DeskJet 560C's output (upper left and right) rivals that of costlier printers.

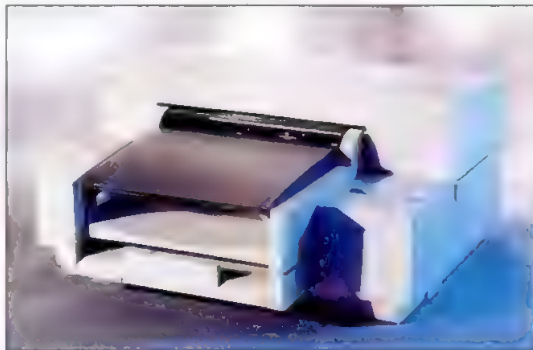
so characters are clear and sharp. The printers also use a version of HP's Resolution Enhancement Technology to adjust the placement of individual dots within the 600-dpi horizontal resolution to smooth curves and angled lines. Most users will need a magnifying glass to be able to tell the difference between the ink jet output and pages printed by a 300-dpi laser.

The DeskJet 560C adds color capabilities to the basic feature set.

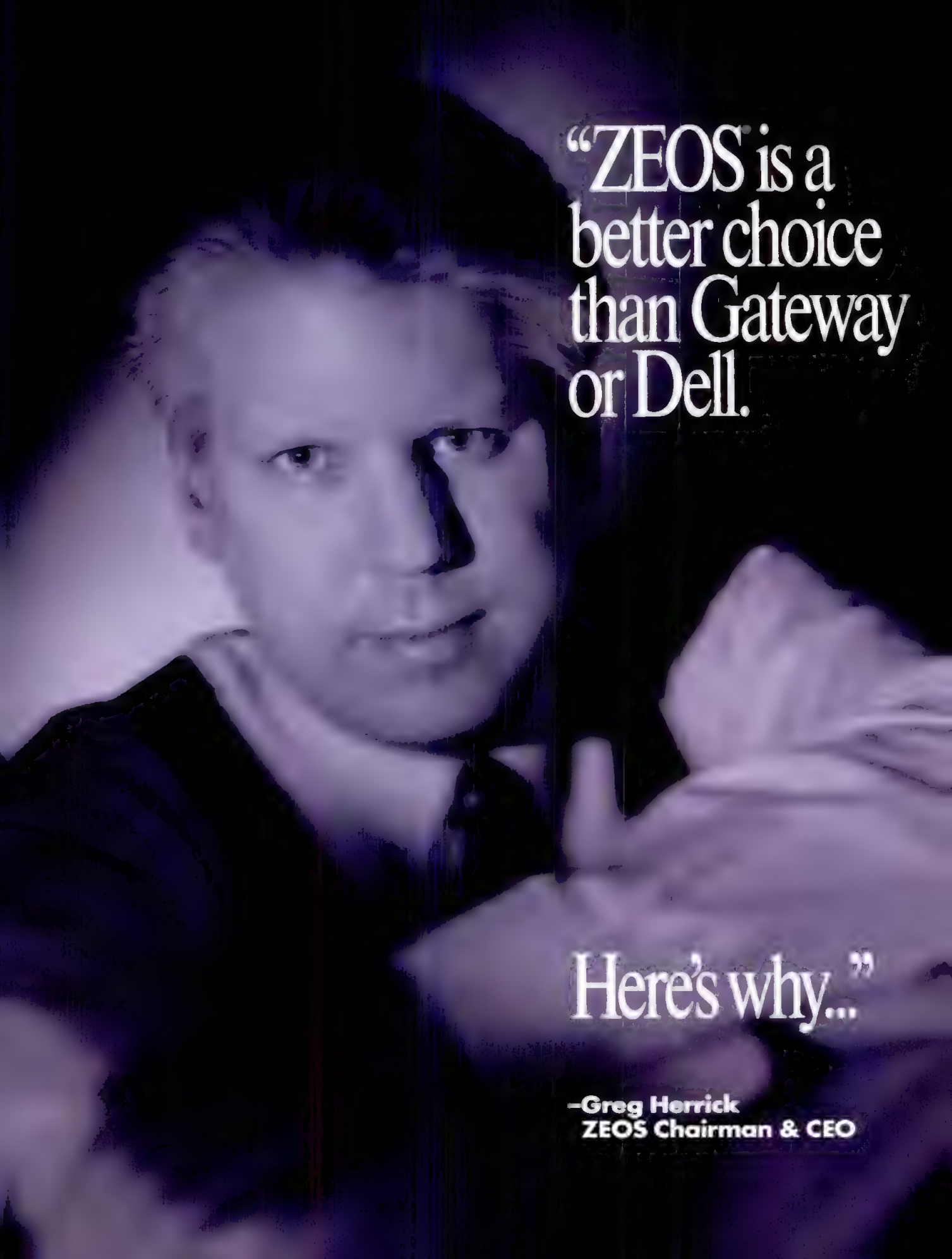
halftone pattern, and spot color—such as solid color used for text or charts—is printed with minimal dithering. The result is uncompromising output quality for different kinds of color images on a single page. The color output from this printer rivals that from printers that cost two or three times as much.

LESS THAN LASER SPEED

With laser-quality text on both printers and page-printer-quality graphics on the DeskJet 560C, you might start to wonder what you have to give up for the low price of these new printers. The answer is time: Compared with



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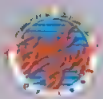
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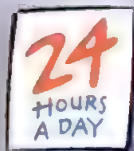


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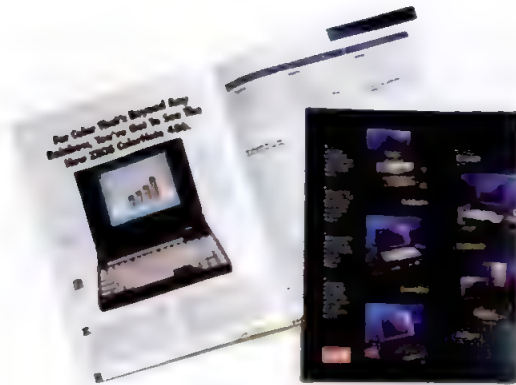


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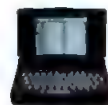
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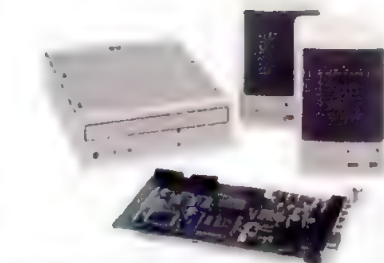
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First Looks

HP Printers

CONTINUED FROM PAGE 48

lasers (though not color page printers), these DeskJets are still significantly slower.

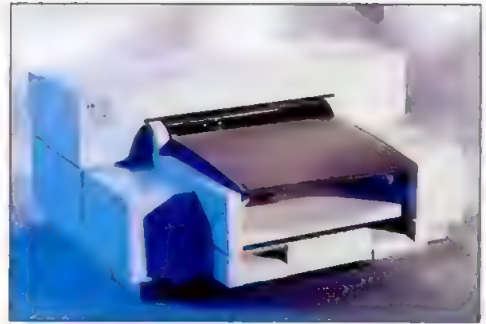
On our text output tests, the HP DeskJet 520 clocked in at 2.9 pages per minute in Normal mode and was 14 percent faster in EconoMode. For graphics (using DeskJet Plus output files), the 520 turned out 2.0 graphics pages per minute. The

DeskJet 560C was slower than the 520 on text, producing only 2.5 ppm in Normal mode; in EconoMode, it was about 10 percent faster. For black-and-white graphics (with DeskJet Plus output files), the 560C, at 1.7 gppm,

was again slower than the 520. These times are a third to a half slower than what you'd expect from a personal laser.

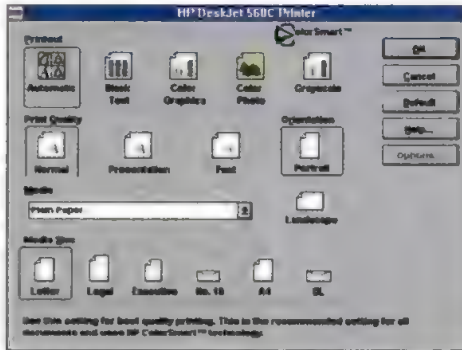
Of course, the average laser printer costs at least twice as much as the DeskJet 520, and although it costs about as much as a DeskJet 560C, it can't print color. So if you want excellent output at a budget price or want to upgrade to color without going broke, one of the two new DeskJets will fit the bill.

• List price: HP DeskJet 520,



DESKJET 560C: A good color alternative.

\$365; HP DeskJet 560C, \$719; Adobe PostScript Level 2 upgrade for DeskJet 560C, \$249. Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051; 800-752-0900. Circle 426 on reader service card



CONTROL: The new Windows 3.1 driver for the HP DeskJets makes them easy to control.

Utilities

Boot Multiple Operating Systems with System Commander's Help

BY SHERYL CANTER

How would you like the ability to run a different operating system—DOS, OS/2, Windows NT—every time you reboot your PC? System Commander, \$99.95 from V Communications, is a tool that lets you select from several operating systems at boot time.

Without a utility to manage multiple operating systems, you're reduced to using FDISK to change the active partition before rebooting, a cumbersome technique at best. At worst, you could make an incorrect selection and trash your hard disk.

To address this problem, OS/2 2.x comes with a utility called Boot Manager. You install Boot Manager in a 1MB partition and designate it as *active*. Then each time you reboot, Boot Manager presents you with a menu of available operating systems.

Unfortunately, Boot Manager doesn't exist compatibly with some non-IBM operating

systems, like Windows NT and some Unix flavors, and it uses up one of the four available partitions on a hard disk.

Like Boot Manager, System Commander displays a menu of available operating systems each time you reboot; however, it uses an entirely different technique. Instead of installing itself in a separate partition, it replaces the master boot record. The original master boot record is backed up in two places: in a hidden file on your hard disk and on your installation floppy disk. System Commander is loaded before any operating system is loaded and uses no resident memory after you've made your selection. We encountered no problems either installing or uninstalling it.

But we did encounter other problems. System Commander

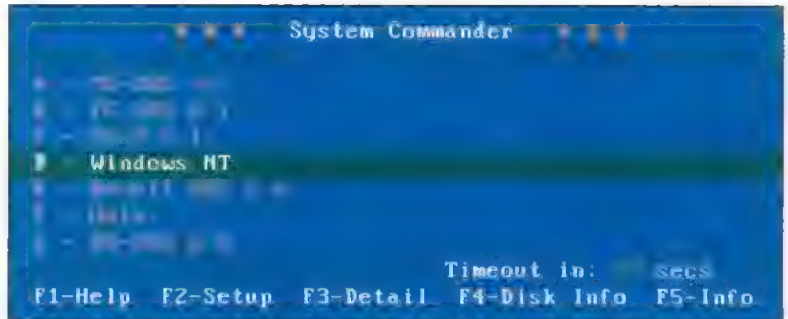
was unable to boot OS/2 2.1 on our test machine because the OS/2 boot record could not be found. When we selected OS/2, the computer hung. To load OS/2, we had to place Boot Manager on the System Commander menu, select Boot Manager, and then select OS/2 from within Boot Manager.

We also encountered diffi-

both these problems are atypical. The company is actively working on solutions and expects both problems to be solved by the time you read this. Neither glitch caused data loss.

TRICKY BUSINESS

Managing the boot process is a tricky business, but it's something that is needed with the



CHOOSE ONE: System Commander gives you a menu of available operating systems each time you boot your PC.

culties when we tried to use System Commander to boot different DOS configurations. Our test system used 4DOS, a replacement for COMMAND.COM from JP Software, and booting into 4DOS worked flawlessly. We then used System Commander's MultiDOS option to add MS-DOS to the menu, but when we tried to boot MS-DOS, the computer hung.

V Communications says that

many operating systems in use today. Though Version 1.0 still has some wrinkles, System Commander offers a clever approach to a difficult problem.

• List price: System Commander, Version 1.07, \$99.95. Requires: DOS 3.0 or later. V Communications Inc., 4320 Stevens Creek Blvd., #275, San Jose, CA 95129; 800-648-8266, 408-296-4224; fax, 408-296-4441.

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PC Week, Jan. 1994

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Voice Recognition

IBM's Dictation System Is Quite a Talk Show

BY RICH MALLOY

Look, Ma, no hands! That's what you'll feel like saying when you use IBM's Personal Dictation System. This amazing new product makes your PC understand every word you say. Similar dictation systems have been available in the past, but this is the first time that such a powerful tool is available for under \$1,000.

The \$998 IPDS, as it is called, consists of a huge software program and a half-length expansion card that contains a digital signal processor (there are different models for ISA and Micro Channel PCs). You need to supply a microphone and an external speaker.

HEAVY RESOURCES

This is no plug-and-play toy. You have to devote a considerable amount of time and resources to get the IPDS installed and running. It requires OS/2 2.1 and at least 8MB of memory above what you would normally use. Since you're running OS/2, you'll need at least 16MB total. As for disk space, IBM says you need 62MB, but you may actually need as much as 13MB more.

Also, don't forget your time. You have to spend 2 hours reading an essay and a Mark Twain short story into the microphone in order to train the system to recognize your voice. And after all that, the IPDS needs a few hours of disk thrashing to digest the pronunciation information it has gleaned from your voice. Yes, it's OS/2—so you can have this task execute in the background while you do other things—but it is best to schedule this part of the training as an overnight task.

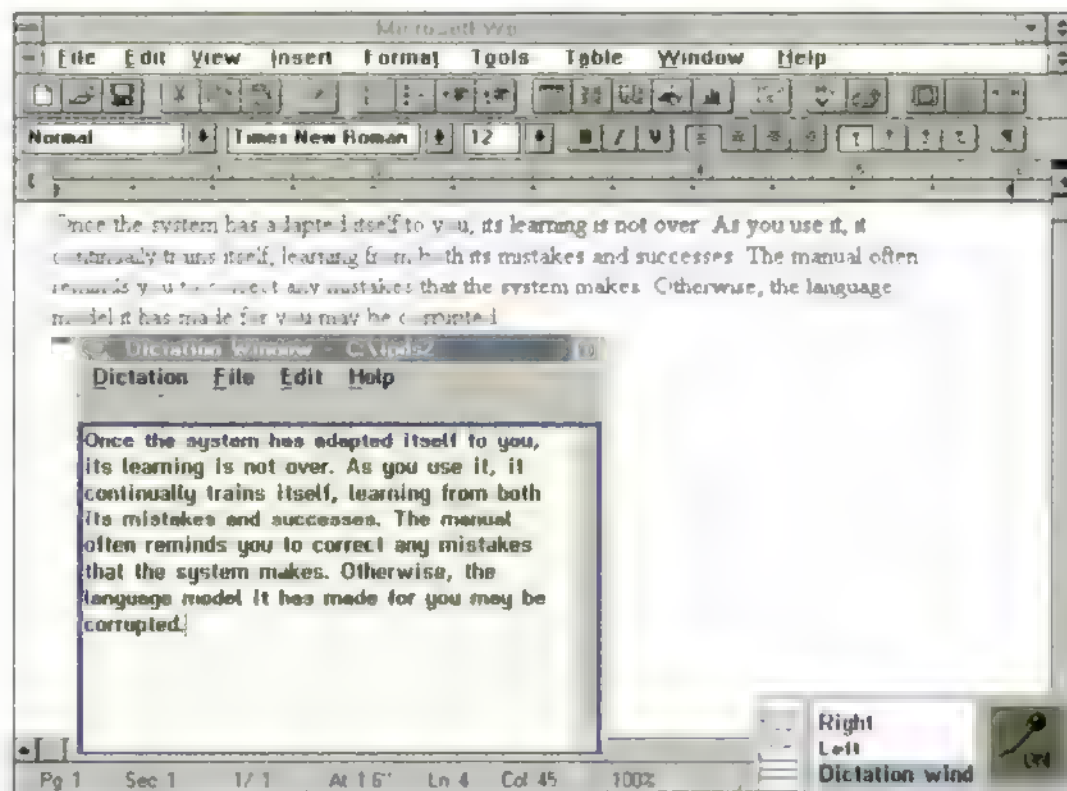
CONTINUAL TRAINING

Once the IPDS has adapted itself to your voice, its learning isn't over. As you use it, it continually trains itself, learning both from its mistakes and successes. The manual often reminds you to correct any mistakes that the IPDS makes. Otherwise, the language model

what you said originally, the IPDS will play a short recording of your voice. After you've corrected the text, you can copy it into any application.

HOW WELL DOES IT DO?

The IPDS was acceptably fast on our test PC, a 486DX2/66 with 16MB of memory. Right out of



SPEAK UP: IBM's Personal Dictation System records your spoken text in its Dictation Window (left), where you can correct any mistakes before pasting the text into a word processor.

it has for you may be corrupted.

Of course, you're undergoing some training as well. The IPDS is not a *continuous* but rather a *discrete* speech-recognition program. It requires a short break before and after each word, and that's an unusual way of speaking. With a little practice you can actually speak quite fast this way, sounding a bit like an angry Michael Caine. The system, however, will lag behind you at about 70 words per minute.

To use the IPDS, you say "Start Dictation" and begin speaking. It recognizes what you say and displays it in a dictation window. You can look it over and correct any recognition errors fairly easily. If you forget

the box, it has a vocabulary of 20,000 words, which is extraordinary. As you train it, the vocabulary can increase up to about 32,000 words. (You can also purchase optional vocabularies for journalism, emergency medicine, and radiology.)

At first, the recognition is a bit spotty and often quite amusing. For example, when we said "DLL" it heard "PLO." Soon, however, you notice it getting better and better. It's rarely perfect, but it's hard to quibble with the success it does achieve. If a 50-word-per-minute typist can dictate at 70 words per minute, the time savings can soon add up. Correcting the dictated text, however, takes longer than cor-

recting typed text, but dictating text is much easier than typing. Just sit back, close your eyes, and mouth off. Instead of carpal tunnel syndrome, your only medical threat is a hoarse voice.

HOW IT WORKS

Since the task of recognizing individual words is so difficult, the IPDS uses context information to help decide what you are trying to say. IBM has developed a huge library of trigrams; that is, three-word combinations, that are common in English. With this information, the IPDS can choose not only among similarly sounding words, but also among homophones—words that sound exactly the same. It can, for example, correctly recognize the sentence "They're going to park their car there."

Taking dictation isn't all the IPDS does. If you're so inclined, you can use it to navigate around OS/2 and certain OS/2 apps. For others, including Windows apps, you have to develop your own voice macros, a mildly tedious task.

The IPDS isn't perfect. Some parts of the program seem unnecessarily complex. For example, just closing the program involves remembering to click the microphone button with the right mouse button. Nevertheless, it's remarkable in its ability to make your job easier. If you do a lot of writing or dictation, it should save you a significant amount of time and make your job less tedious.

Eventually, speech recognition will be a standard feature of new PCs. Until then, if you want to see what the future of computing looks like, or if you just want to become more productive, just speak up.

• List price: *IBM Personal Dictation System: ISA version, \$998; Micro Channel version, \$1,078.* Requires: 16MB RAM, 62MB hard disk space, OS/2 2.1 or OS/2 for Windows. IBM Corp., Armonk, NY 10504; 800-825-5263, 914-765-1900.

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Utilities

PC Tools for Windows Has New Reporting

BY BARRY SIMON

The new release of Central Point Software's \$179.95 PC Tools for Windows adds some of the features you've seen in Hewlett-Packard's Dashboard, Symantec's Norton Desktop for Windows 3.0, and Systems Compatibility Corp.'s OutsideIn to produce one of the strongest

Windows utility collections available.

Version 2.0 doesn't include many new modules; instead, much of what was in Version 1.0 has been significantly beefed up. The core is the same: a desktop manager that supports multiple virtual desktops and a file manager that can be run independently of the desktop. Add to

that virus protection, a backup feature with QIC and SCSI support, a disk optimizer, a disk fix utility, a batch language, a system report utility, and a great icon editor and you get the idea of how much is included.

The major new module—CrashGuard—is a performance monitor that may remind you of Dashboard. It displays available memory, resources, disk space, and the date and time. You can configure it to pop up a message and sound an alarm when memory is short or resources are running low.

PC Tools' File Manager, already our favorite among the many Windows File Manager replacements available, has new bells and whistles. There's support for PKZIP 2.0 and LHA 5 compression, new graphics viewers that can zoom into graphics or fit them into a window, and a DOS-like command line with a

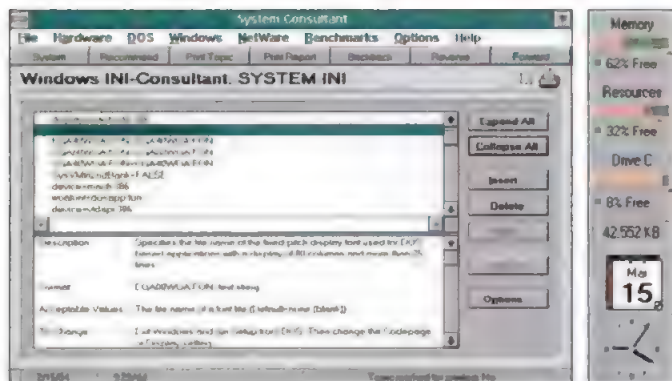
history list, a duplicate file locator, and a hex file compare.

Central Point has added an INI Consultant to the System Consultant so you can view your WIN.INI and SYSTEM.INI files and get explanations of their contents in plain English. If you need to, you can edit them on the spot. DOS 6 users should also note that the various disk utilities have support for drives compressed with DoubleSpace.

Every current user of PC Tools for Windows should upgrade, and if you're setting out to buy your first Windows utility program, you'll find PC Tools an excellent collection.

• **List Price:** PC Tools 2.0 for Windows, \$179.95; upgrade (from PC Tools, Norton Desktop, Dashboard, or XTree for Windows): \$49.95. Requires: 4MB RAM, 18MB hard disk space (complete installation), Microsoft Windows 3.1. Central Point Software, 15220 NW Greenbrier Pkwy, #100, Beaverton, OR 97006; 800-964-6896, 503-690-8088; fax, 503-690-8090.

Circle 420 on reader service card



BETTER INFO: On the left, PC Tools' System Consultant. On the right, the new CrashGuard.

Sound/SCSI

Adaptec Combines SCSI and Sound in One \$399 Adapter

BY JAMES KARNEY

Adaptec has turned the tables on sound card vendors who put SCSI and CD-ROM support on their cards. Cards in Adaptec's AME-157x series have both Fast SCSI-2 host adapter capabilities and a built-in Microsoft Windows Sound System with Sound Blaster compatibility. The \$395 kit includes the card, a microphone, earphones, a cable, an external connection bracket, and Adaptec EZ-SCSI and EZ-Audio software.

There are two cards in the series, which are identical except for the fact that the AME-1572 has a floppy disk controller and the 1540 does not. The SCSI portion has an on-board BIOS that can boot a PC from a compatible

SCSI-1 or SCSI-2 hard disk. Both cards can operate up to six SCSI devices that are ASPI (Advanced SCSI Programmable Interface) compatible, and the card uses a Digital Signal Pro-

cessor (DSP) to operate the sound functions. That means you can enhance or extend features through software upgrades.

We installed the AME-1572 in a 66-MHz 486 system with a 545MB Fast SCSI-2 drive and two external devices: a NEC MultiSpin 4x CD-ROM and a Colorado Memory Systems PowerTape drive. Unlike some of Adaptec's other adapters, the

AME-1572 still has jumpers for configuring the hardware setup.

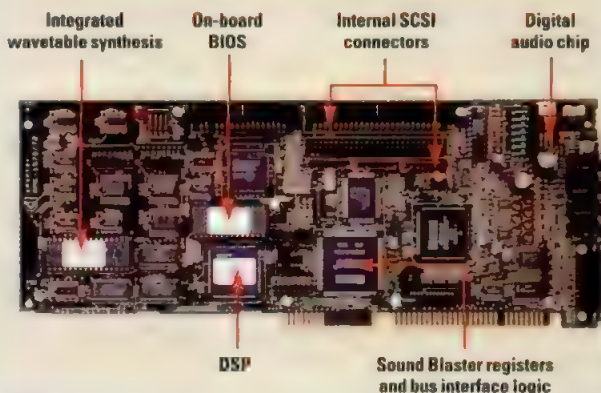
Every multimedia CD-ROM we tested for Sound Blaster compatibility worked fine, as did Windows Sound Systems' Voice Pilot voice-recognition software. The AME-1542 handled the tasks at least as well as the original Microsoft product, and the sound quality was very good.

If you're a power user looking for high-quality sound with advanced wave-table functions or a high-performance Fast SCSI-2 host adapter, the AME-1572 may not meet all your needs. But if you're looking for a good sound card with better-than-average SCSI abilities, this adapter may strike just the right note.

• **List Price:** Adaptec AME-1572 Kit, \$399. Requires: 16-bit ISA slot, DOS 5.0 or higher, Windows 3.1. Adaptec Inc., 691 S. Milpitas Blvd., Milpitas, CA 95035; 800-442-7274, 408-945-8600; fax, 408-262-2533.

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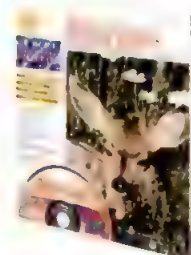
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Accounting

In The Black: For Personal And Business Accounting

BY KATHY YAKAL

Microrim markets *In The Black* (\$89.95) as three applications in one: an easy-to-use double-entry accounting program, a contact manager, and a personal finance manager. Built on Microrim's powerful R:BASE database manager, it's simple enough to keep an accounting novice happy yet has enough accounting controls to please a CPA.

In The Black is missing modules (such as an Inventory or Payroll module) that today's best low-end accounting programs include, and its contact management capabilities can't compare with those of a full-blown contact manager. Its simplicity and accessibility, however, will appeal to small-business executives who need sales and receivables tracking with an ironclad audit trail.

The program imports existing databases in ASCII-delimited format and comes with 28 modifiable sample Charts of Accounts. It has complete General Ledger functions and lets you set up accounts receivable and accounts payable. You can design and print product, professional, and service invoices on pre-

printed forms, letterhead, or plain paper. Recurring bills—as well as invoices—are automated so you don't miss payments or forget about a payment due you. *In The Black* doesn't have as many prefabricated reports as many comparable products, but the ones you do find can be customized and printed to the

screen or printer, or exported to another application.

While *In The Black* doesn't measure up to the best low-end accounting programs, its sales and receivables modules compare favorably with the similar modules found in some of those packages. You assign individual tax rates for contacts and payment terms and track product and service items (though not to the extent that you can in other programs using their inventory modules). When it's bill-paying time, you have a wide variety of filters to choose from in selecting which bills to pay.

AUDIT TRAILS

Error correction works exceptionally well. Where some comparable financial packages let you simply delete a transaction (leaving no trace of it anywhere) and others require a manual reversing entry, *In The Black* strikes a compromise. For exam-

ple, you have the ability to change invoices until they are recorded. After that, you can change or void them. *In The Black* automatically records a reversing entry, and you can automate recurring reversed transactions (for routine adjusting entries).

In an effort to ease the pain

of learning double-entry book-

keeping, *In The Black* includes

an unusual feature. By clicking

on the language icon, you can

toggle back and forth between

accounting terminology and

nonaccounting terminology.

Chart of Accounts, for example,

becomes *Category*. There's a

certain amount of theory you

must understand to use any

accounting product, however, so

the effort isn't especially useful.

In The Black's interface

design is most helpful in guiding

you through the overall process.

Easily recognizable icons represent

functions like writing

checks, making payments, and

generating an Accounts Payable

or Accounts Receivable invoice.

You just click on those icons, or

on a menu item, and fill in the

blanks, choosing from pick lists

whenever an arrow indicates

that one is available.

The Card File is the heart of

In The Black's contact manage-

ment system. As in any account-

ing program, you fill in details

about every individual and com-

pany that affects your financial

system. Later, you pop up these

records anywhere in the pro-

gram, set up an unlimited num-

ber of contacts, and attach an

unlimited number of notes to

each. Each time you open the

program, you see a list of items scheduled for that particular day, such as checks to print and invoices due for collection.

FINANCE AT HOME

In The Black also has features targeted at users who want to track personal finances. Loan, college, and retirement planners help you assess where you are and help you plan for the future. A Credit Card Manager tracks your progress in paying off those lingering payments. And financial data can be imported in .TXF format, the standard format accepted by most personal tax preparation programs.

If you're using *In The Black* strictly as a personal finance manager, you'll find that most of the functions on the personal side of the program overlap with the functions that are used by businesspeople, except that as a

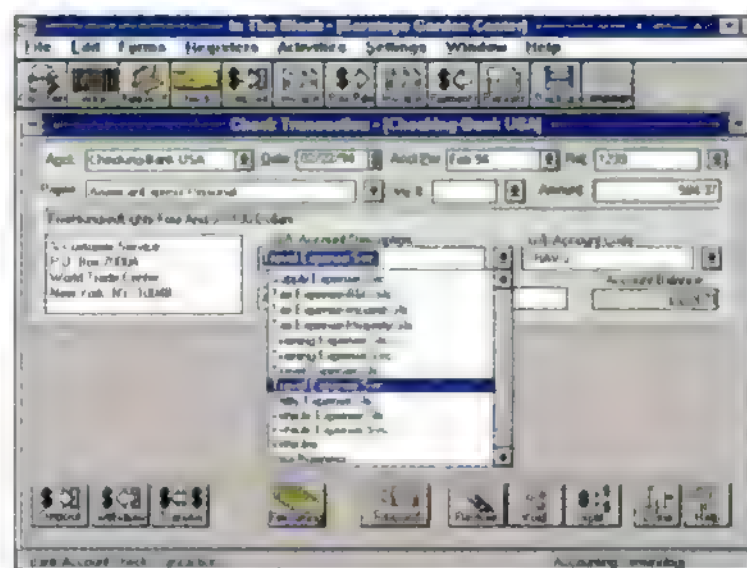
personal user, you'll select a Chart of Accounts that's geared specifically to personal finance.

During testing (we used a 66-MHz 486DX2 test system), *In The Black* ran slower than similar applications. Written documentation and the technical support staff are helpful, but on-line help is sadly lacking, offering only a brief index of topics when you hit the F1 key or pull down the Help menu.

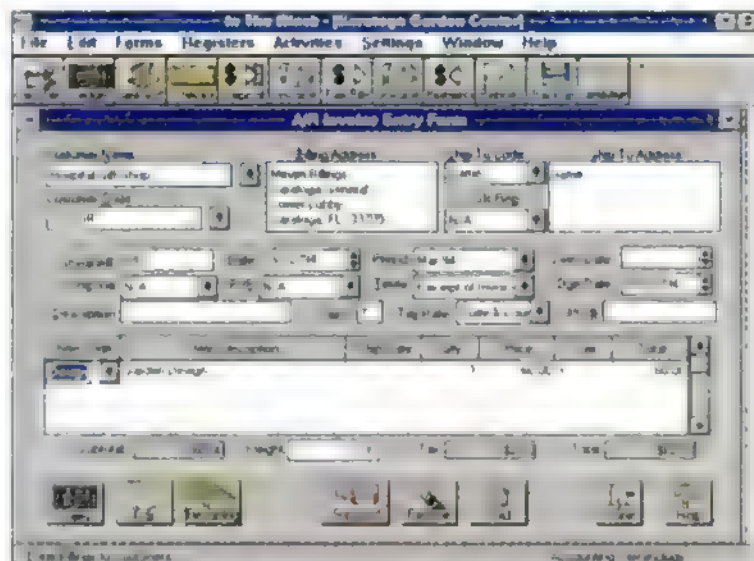
In The Black is an in-between kind of financial manager. It offers more than simple checkbook programs but less than typical entry-level accounting packages. It's best suited for users who find their needs somewhere in between the two.

• List price: *In The Black*, \$89.95. Requires: 4MB RAM, 13MB hard disk space, Microsoft Windows 3.1. Microrim Inc., 15395 SE 30th Pl., Bellevue, WA 98007; 800-628-6990, 206-649-9500; fax, 206-746-9438.

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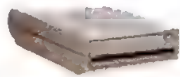
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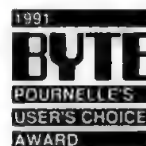


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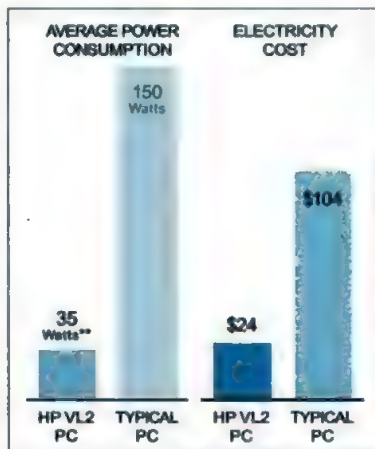
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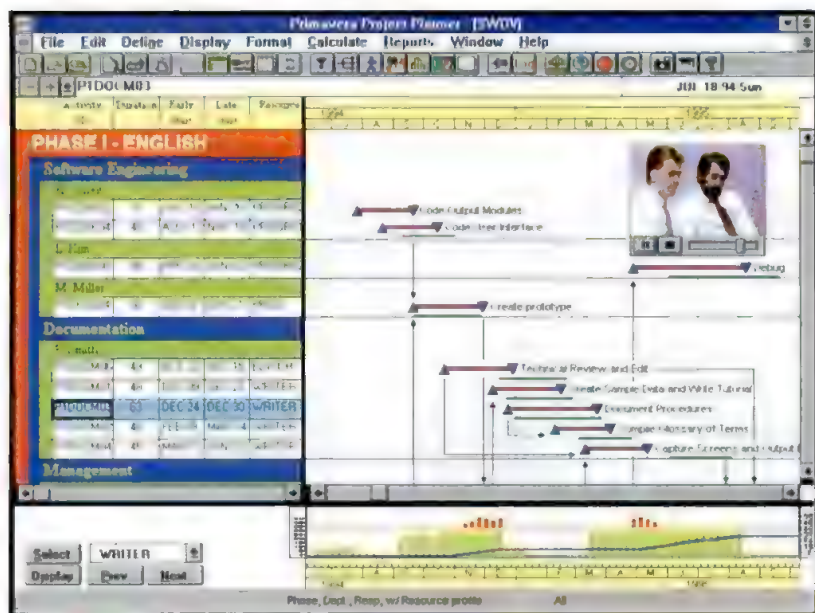
Our PCs come with a whole laundry list of features.⁶ But the features that distinguish these PCs from all others won't be found on any spec sheet. They're the reliability and assurance you get from HP standing behind the products they make. No wonder BIS Strategic Decisions has called HP "the fastest-growing PC company in the U.S." Call 1-800-322-HPPC, Ext. 8088 for more information or for the Hewlett-Packard dealer nearest you.



Annual electricity costs based on PCs (including monitors) running 24 hours a day. **Power consumption of the HP Vectra VL2 and HP 14-inch Ergonomic 1024 display (D2805A) in sleep mode. The HP Vectra VL2 daily usage reflects 3 hours active, 5 hours standby, and 16 hours sleep mode, for an average consumption of 35 watts. Potential annual cost savings based on 1,000 PCs using 35 watts each versus typical PC consumption of 150 watts. Electricity costs of 8 cents/Kwh assumed. Actual savings may vary. HP 14-inch Ergonomic 1024 display (D2805A) with Display Power Management System is used in calculation.

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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Adam A. Hicks

NEW

Now You Can Run Notes Off a NetWare Server

With parents like **Lotus Development Corp.** and **Novell**, Lotus Notes Server for NetWare is generating high expectations. As a NetWare Loadable Module (NLM), Notes' workgroup capabilities will be more accessible to more LAN administrators. Lotus Notes Server for NetWare integrates seamlessly with NetWare both in code and support, and both Lotus and Novell provide technical and sales training to resellers. Currently compatible with NetWare, Versions 3.12 and 4.01, the package supports a variety of protocols including those for Macintosh clients (AppleTalk, TCP/IP); Windows, OS/2, and Unix clients (SPX/SPXII, TCP/IP); and OS/2 and Unix servers (SPX/SPXII, TCP/IP). The software requires a 386 processor or better, 12MB of RAM, a 200MB hard disk, and LAN adapters.

• List price: *Lotus Notes Release 3.1 Server for NetWare*, \$495. **Lotus Development Corp.**, 55 Cambridge Pkwy., Cambridge, MA 02142; 800-346-1305, 617-577-8500; fax, 617-693-0968.

Circle 405 on reader service card

NEW

Caution: Memory-Module Failure Ahead

Qualitas is worried about your RAM even if you're not. **RAMexam**, another package in Qualitas's line of system-testing software, addresses potential RAM module failures caused by static electricity, power surges, temperature changes, and other kinds of daily wear and tear. **RAMexam**'s evaluations are more extensive than your PC's normal power-on self-test. Complete evaluations to identify problems such as unlinked/linked inversions and transition faults can be scheduled at specified intervals or done manually at any time. (Unfortunately, the package isn't called **RAMfix**.) **RAMexam** works on any system equipped with a 386 or better.

• List price: *RAMexam*, \$29.95. **Qualitas Inc.**, 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; 800-733-1377, 301-907-6700; fax, 301-907-0905.

Circle 406 on reader service card

HOT PROSPECT



Keeping Private Data Private On the Road

If you travel with highly sensitive information on your notebook PC, you may worry about how to protect it from prying eyes. **Telequip Corp.** has introduced an intriguing solution for securing mobile data. **Crypta Plus** PCCMCIA memory cards let you swap memory from notebook to notebook, as do other mobile memory cards, but they add the advanced security functions of public-key cryptography and digital signature.

The cards provide two types of protection. First, there's no way for anyone to access the information without using a password that's built directly into the silicon and protected to ensure the codes are electronically and physically impenetrable. Second, during data transmissions, secure key storage ensures that communications will arrive unread.

This technology is sure to permeate more markets, and it is being promoted as an enabling technology for "smart cards" that may someday replace your wallet and your bank card (*Trends*, March 29, 1994). But for now, it provides a high level of security for personal or corporate data at a modest premium.

• List price: *Crypta Plus*, approximately \$50 over market cost of memory. **Telequip Corp.**, 18 Clinton Dr., Hollis, NH 03049; 800-225-0580, 603-881-5616; fax, 603-881-5635.

Circle 404 on reader service card

NEW

Toshiba Steps Up Its Entry-Level Notebooks

The new members of **Toshiba America Information Systems'** Satellite notebook line, the 6.5-pound **Toshiba Satellite T1910** and the 6.8-pound **Toshiba Satellite T1910CS**, are attractively priced but don't skimp on options. The difference between the two models is found in their displays. The T1910 has a monochrome VGA screen; the T1910CS has a dynamic dual-scan color VGA screen. Both have 9.5-inch diagonal screens and 640-by-480 resolutions.

Targeted to fill the ever more demanding consumer market, the systems can be purchased along with a software bundle that includes **ClarisWorks** for Windows, **Lotus Organizer**, a video from Toshiba, and a carrying case. The instructional video shows new users how to do basic setup of the systems, each of which includes a 33-MHz i486/SX CPU with 8K internal cache, a 120MB hard disk, 4MB of RAM expandable



T1910CS is one of two new Toshiba notebooks.

up to 20MB, and a proprietary PCCMCIA slot that is designed to hold Type I, II, and III cards, as well as the yet-to-be-standardized 14.5-millimeter Toshiba card. A full-size 82-key keyboard and

Microsoft BallPoint Mouse, Version 2.0 (with QuickPort), along with a serial mouse and a front-loading 1.44-inch floppy disk drive round out the systems' features.

Using power management features including automatic display and hard disk shutdown, CPU sleep mode, and even a BIOS manager to find idle time between keystrokes, the T1910CS has an estimated battery life of 2 hours, while the T1910 runs closer to 3 hours.

• Estimated street price: *Toshiba Satellite T1910* starts at \$1,599; *Toshiba Satellite T1910CS* starts at \$2,299. **Toshiba America Information Systems Inc.**, 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000.

Circle 407 on reader service card

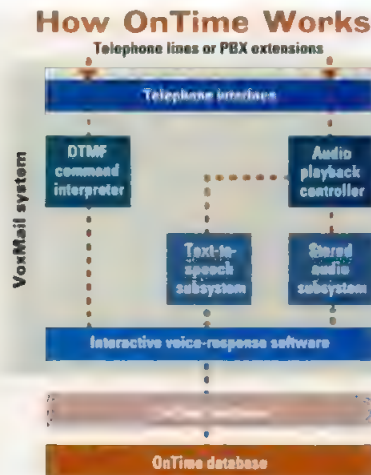
New & Improved

NEW

Reach Out and Touch Your Calendar from the Road

Forget modems and remote e-mail packages on your business trips. **WordPerfect Corp.**'s WordPerfect Office Telephone Access Server or **Campbell Services'** OnTime Interactive Voice Response System have turned scheduling, e-mail, and personal calendars into voice mail—complete with code words, interactive prompts, and help features.

WordPerfect uses a licensed version of OS/2 SmoothTalker, while OnTime employs VoxMail to convert its calendaring/scheduling packages into oral data-bank phone centers. If you're on the road or support people on the road who need to coordinate and update communications, these systems will provide the basic tools you'll need.



When you call in, you can get messages (including e-mail) or book a meeting in the next town (and get confirmation). Both packages require dedicated hardware. WordPerfect requires a system with a 386-or-better processor, a minimum of 8MB of RAM, OS/2 2.0 (2.1 is recommended), WordPerfect Office Message Server, one or more Dialogic boards, and a phone line. OnTime needs a system with a 286 processor or better, 640K RAM, a VoxMail card, and VoxMail DOS (with DOS 5.0 or later) or OS/2 (with OS/2 2.1 or later).

- List price: *WordPerfect Office Telephone Access Server*, \$9,995. **WordPerfect Corp.**, 1555 Technology Way, Orem, UT 84057-2399; 800-861-2507, 801-225-5000; fax, 801-228-5077.

Circle 408 on reader service card

- List price: *OnTime Interactive Voice Response System*, \$10,000. **Campbell Services Inc.**, 21700 N. Western Hwy., #1070, Southfield, MI 48075; 800-345-6747, 810-559-5955; fax, 810-559-1034.

Circle 409 on reader service card

BRIEFS

GREEN COMPUTING

Digital Equipment Corp.'s latest family of PCs, the DECpc LPv+ line, is Energy Star-compliant. Included in the line are five desktop systems ranging from a 486SX/25 model to a 486DX2/66 model. Prices list from \$1,049 to \$1,799 for units that include 4MB to 64MB of RAM, hard disks from 170MB to 340MB, one floppy disk drive, DOS, and Windows—but not a monitor.

Also in the family is a notebook, the DECpc 425SE, that's available with either a monochrome or a dual-scan passive-matrix display. The system comes with a 486SX/25 processor, 4MB of RAM, a 120MB or 170MB hard disk, and one Type III PCMCIA slot that can also hold two Type II cards. The monochrome system weighs 5.5 pounds; the color system weighs 6.2 pounds. Prices range from \$1,899 to \$2,749.

A more powerful notebook, the DECpc 433 SLC Premium, has a 486DX/33 processor, a 9.5-inch active-matrix color display, 4MB of RAM, a 200MB hard disk, and a Type III PCMCIA slot. Optional docking stations are available for the \$4,399 system. 800-722-9332.

Amdek's new line of monitors includes two large Energy Star-compliant models. The 17-inch Amdek AM/817E (\$839) supports a maximum resolution of 1,600-by-1,200 noninterlaced with a 60-Hz refresh rate. The 15-inch Amdek AM/815E (\$379) has a maximum resolution of 1,280-by-1,024 noninterlaced. Both power down to below 30 watts in two stages. 800-722-6335.

B&B Electronics' \$69.95 Green Keeper helps you keep electricity costs down. You plug the hardware device into your keyboard port and then plug your monitor, printer, modem, or other peripheral into its AC outlet. The included software lets you turn off the connected peripherals after a time interval you specify. 815-434-0846.

HOME COMPUTING

The Software Toolworks' Windows-based CardShop Plus! (\$39.95) helps you create greeting cards, certificates,

IMPROVED

Recognita 2.0A Does OCR On 80 Languages

Recognita Plus, Version 2.0A, International Edition, from **Recognita Corp.**, is one of the few optical character recognition (OCR) packages to support Hewlett-Packard Co.'s AccuPage 2.0 technology, making it more accurate and easier to use. Recognita helps you get better quality from smaller fonts (down to 4 points) and manage diverse page layouts. AccuPage improves the performance of the package, which recognizes 80 Latin-based languages, including all fonts and accents.

- List price: *Recognita Plus, Version 2.0A, International Edition*, \$795; free to registered users of Version 2.0 American five-language edition, \$595. **Recognita Corp. of America**, 1156 Aster Ave., Suite F, Sunnyvale, CA 94086; 408-241-5772; fax, 408-241-6009.

Circle 410 on reader service card

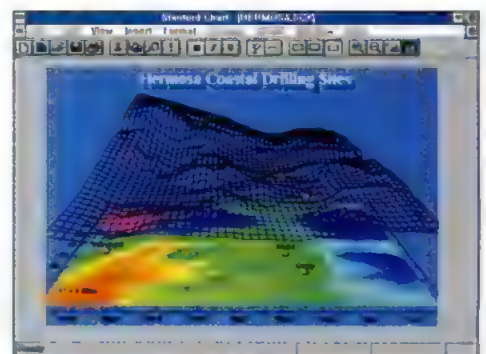
NEW

Add Complex Graphs Simply with Stanford Chart

3-D Visions (makers of Stanford Graphics for Windows) has been bought by **Visual Numerics**, which will continue to produce Stanford Chart. The graphing component of the high-end package Stanford Graphics for Windows has been pulled out to create an OLE 2.0-compliant utility to add 2-D or 3-D graphs (165 different types) to any Windows program. The package is designed to place graphs into documents quickly or to enhance presentation packages with graphing styles including bubble charts and error bar plots.

- List price: *Stanford Chart*, \$79. **Visual Numerics**, 9990 Richmond Ave., #400, Houston, TX 77042-4548; 800-729-4723, 713-784-3131; fax, 713-781-9260.

Circle 423 on reader service card.



Stanford Chart does 3-D surface plotting.

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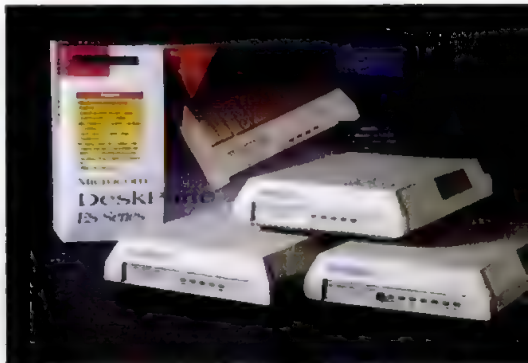
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Help with DOS files.

Our Windows products have the best compatibility with your existing DOS files. So you don't have to leave anything behind. Plus, it's easier to work with other people who haven't moved to Windows. You can even switch back and forth between platforms if you want.

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Instead of learning new Windows programs, why not let them teach you? The Borland Office has "Coaches" to show you how things work. Plus it has "Experts" and "Macros" that will perform complex tasks for you. So you don't have to

learn anything at all.

Our Transition Advisor can even teach you the new key commands. Or if you prefer, we can make your WordPerfect® menus and commands exactly like DOS. Nothing to it.

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Only the Borland Office gives you the three MVP products in the categories you want most—word processing, spreadsheets, and database.

WordPerfect 6.0 for Windows.

More than just a word processor, it's a complete document processor with integrated text, data and graphics.

And it directly imports more types of spreadsheets, graphics and even database information than any ordinary word processor.

Borland Quattro® Pro 5.0 for Windows. It's the easiest-to-use spreadsheet with the most analytical functions and graphical tools available. No wonder it's received more awards and recognition than any other spreadsheet. Ever.

Borland Paradox® 4.5 for Windows. It's the best-selling PC database. And with good reason. It features built-in SQL connections to all the popular database servers for instant, easy access to all your data.

Help sharing.

Unlike other suites, every product in the Borland Office is workgroup-ready right out of the box. So you can share database information with your co-workers and insert their spreadsheets, automatically receiving updated data. The Workgroup Desktop makes distribution easy. And you don't have to buy any additional hardware or software.

Help working.

Of course, the Borland Office keeps helping you after the move. The Desktop Application Director (DAD) makes it easy to switch between



The Desktop Application Director (DAD) makes it easy to switch between applications and commonly-used tasks.

applications. And PerfectFit Technology means that the programs share button bars, icons, cross-application macros, even resources like spell checking. So each product "looks and feels" the same.

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**WordPerfect 6.0
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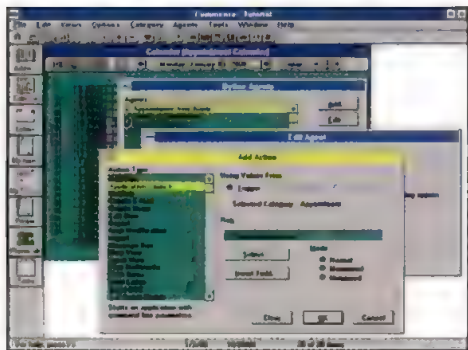
US Facts and Trivia on Your PC

Software Marketing Corp.'s *InfoNation—Rating the USA to Z*, contains information on 1,200 topics covering all 50 states that you would normally have to find separately in atlases, census reports, government listings, national park directories, and road maps. You can combine search topics to find the perfect city to relocate or travel to, or browse through satellite maps and databases of information to increase your trivia knowledge, then print customized maps or compare statistics. • List price: *InfoNation—Rating the USA to Z*, \$49.95. **Software Marketing Corp.** 9830 S. 51st St., Building A #131, Phoenix, AZ 85044; 800-545-6626, 602-893-3377; fax, 602-893-2042. Circle 424 on reader service card.

IMPROVED

Fifteen New Features Spruce Up Commence 2.1

Version 2.0 of **Jensen-Jones**'s *Commence* was one of the more flexible (and consequently complex) products reviewed in our roundup of contact-management software ("Contact Management: Keeping in Touch," August 1993). The new Version 2.1 touts 15 new features, ranging from e-mail enabling to changes in interface capabilities and appearance. *Commence* sends text messages or letter templates



Updated interface for Commence 2.1 eases use.

supporting CMC, MAPI and VIM messaging protocols. You can search the database without using exact spellings, and the database can be shared either across the network or with those not connected to a LAN.

• List price: *Commence, Version 2.1, standalone/client or server edition*, \$395; 3-user and 10-user packs, \$695 and \$1,995, respectively. **Jensen-Jones Inc.**, Parkway 109 Office Center, 328 Newman Springs Rd., Red Bank, NJ Circle 413 on reader service card

BRIEFS

HOME COMPUTING

and stationery. Included are 400 pieces of clip art (which can be modified or combined with .WMF and .BMP imports) and more than 100 ready-to-print templates. Prints to color or black-and-white printers. 415-883-3000

Banner Blue Software has released the first Windows version of its popular *Family Tree Maker* genealogy package. The \$59.95 program takes advantage of Windows' graphical flexibility to offer more ways of looking at family trees and printing them out. The capacity of family files has also been massively increased to 1 million people. 510-794-6850.

Ace Software has shipped four Windows-based home-computing packages, each priced at \$29.95: *AtHome Club Organizer*, which tracks memberships, dues, and events; *AtHome Household Organizer*, for managing records, collections, and home inventory; *AtHome Office Organizer*, which handles sales leads, customer lists, and invoicing; and *AtHome Personal Post Office*, for designing mailings and creating labels. 800-345-3223, 408-451-0100.

If you've been to the mall lately, you've probably seen those inscrutable posters which, when stared at long enough, suddenly resolve into amazing 3-D images. Now you can make your own. **I/O Software** has released *Stereofusions*, a \$49 Windows program that creates the images from any .BMP or .WMF file. 909-483-5700. A similar program, *Stereograms!*, from **Lifestyle Software Group**, costs \$39.95. 904-825-0220.

Small-business executives may want to take a look at the improved *One Write Plus*, Version 4.0, from **NEBS Software**. The new version (\$69.95) has pull-down menus that require little knowledge of accounting terminology, yet the program complies with GAAP (Generally Accepted Accounting Principles). There are two different kinds of help, and an audio cassette is included to guide new users through the program. 603-880-5100.

NEW & IMPROVED

Organizing Images in And out of the Office

As more PC users embrace document imaging to reduce large piles of paper, management of those electronic images creates a challenge that two established imaging companies—**Soda Creek Technologies** and **PC DOCS**—are addressing. When used with SCT*Image, a document-imaging engine developed by Soda Creek Technologies, SCT*Filer adds functionality for dealing with large numbers of images. SCT*Filer works as a standalone filing cabinet, or it can be combined with other applications and databases, giving you the power to store, index, retrieve, view, print, and fax imaged documents. SCT*Filer is based on Microsoft Access, so it has full Open Database Connectivity.

For moving imaged files beyond the office, *PC DOCS*, Version 2.0, has been improved to include support for mobile users. You can "check out" documents through a direct connection to a LAN or by copying them onto floppy disks, and their profiles will be automatically updated when you return them. Version 2.0 also includes a storage-management utility to move documents and integrate them with other applications, including Lotus 1-2-3, Lotus Notes, Quattro Pro, and VIM and MAPI-compliant applications.

• List price: *SCT*Filer, single-user version*, \$1,600. **Soda Creek Technologies Inc.**, 2953 Bunker Hill Ln., #104, Santa Clara, CA 95054; 408-980-3530; fax, 408-980-9146. Circle 414 on reader service card

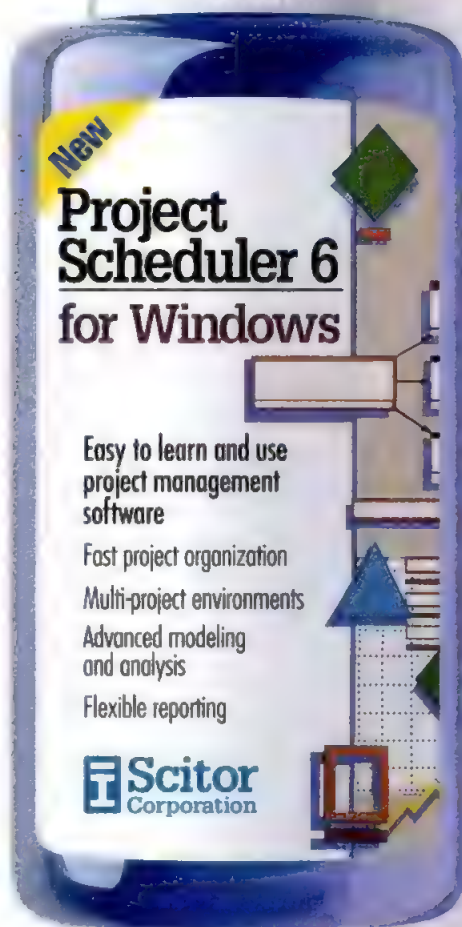
• List price: *PC DOCS, Version 2.0*, \$299 per workstation; \$495 per server. **PC DOCS Inc.**, 124 Marriot Dr., Tallahassee, FL 32301; 800-933-3627, 904-942-3627; fax, 904-566-5559. Circle 415 on reader service card

IMPROVED

Schedule Project Goals with MileStones Etc.

Kidasa Software has released an update to its entry-level scheduler, *MileStones Etc.*, Version 4.0. It's not quite a PIM, nor is it as advanced as a full-scale project manager. Instead, it is a combination of the two. As in the previous version, you define the basic steps of a project, setting symbols for different tasks and their time frames for completion. You end up with as basic or complex a graphical representation of a project as you want. Improvements in Version 4.0 include full OLE 2.0 compliance,

FAST RELIEF FOR PROJECT MANAGEMENT STRESS, BIG OR SMALL.



In the real world of project management, the only constant is change. Managers are faced with coordinating more activities in less time, with tighter budgets, and workgroups spread out across the building and around the world. So what can managers at all levels of experience count on to keep them up to date and in control – Project Scheduler 6 for Windows!

Unlike many software programs that claim to be easy to use, Project Scheduler 6 for Windows really is, and the experts agree. According to a recent *InfoWorld* review, "Project Scheduler's interface is a joy to use...Scitor understands how people use project management software."¹

But Project Scheduler 6 offers managers more than just relief from occasional project stress.

"Project Scheduler 6 surpasses Microsoft Project and CA Super-Project – in addition to challenging many high end packages," wrote *InfoWorld*.²

Sophisticated modeling features, like the Advanced Resource Tracking Spreadsheet (ARTS)³, let you evaluate resource costs and usage on a period by period basis using a familiar spreadsheet

format. Evaluating "what-if" scenarios is also a breeze with Project Scheduler's ability to perform multiple undo/redos in seconds.

Our software's built-in object-oriented report writer provides extraordinary flexibility and convenience. And as the first project management software to share information with other ODBC-compliant applications, it even helps build greater reporting and data management efficiency throughout the enterprise.

So, as *Windows Magazine* recently put it "If you're seeking a Windows project management product that does it all and then some, Project Scheduler 6 fills the bill."



Before you make a project management software decision, call for this free executive summary

Call 415-570-7700

Scitor
Corporation

New & Improved

MDI support, basic drawing tools (for custom importing of comma-delimited files and custom designs and art).

• List price: *MileStones Etc., Version 4.0*, \$149 for single-user version; *workgroup licenses available*. Kidasa Software Inc., 1114 Lost Creek Blvd., #3000, Austin, TX 78746; 800-765-0167, 512-328-0167; fax, 512-328-0247.
Circle 416 on reader service card

NEW

At \$795, trueSpace Is Actually a 3-D Graphics Bargain

Caligari Corp.'s trueSpace delivers advanced 3-D graphics for a surprisingly low price of \$795. With photo-realistic rendering and organic modeling features, trueSpace is targeted at graphics, video, and design professionals who need to create slide-ready (8,000- by 8,000-pixel) illustrations or 3-D animations in a very intuitive interface.

Numerous options for manipulating and viewing objects are clearly displayed, while accelerated graphics routines prevent jerky delays. trueSpace lets artists design objects in a virtual workspace as if they were working with



The virtual workplace puts objects in perspective.

clay. You can apply colors and textures (including orange peel and stucco), add lights and cameras, and put the whole object or objects in motion, saving the show to an .AVI file.

• List price: *trueSpace*, \$795. **Caligari Corp.**, 1955 Landings Dr., Mountainview, CA 94043; 415-390-9600; fax, 415-390-9755.
Circle 418 on reader service card

NEW

Logical Decisions Decides To Do Windows

Faced with a difficult "multimeasure decision"? Look into the new Windows version of Logical Decisions, a program designed to reach logical-

BRIEFS

ERGONOMIC COMPUTING

Everybody stretch. Two software vendors have released packages that encourage you to take a break from your typing to shake out those stiff arms and tired fingers.

Changing Seasons Software has released the Windows-based *Relaxize* (\$49.95). At user-preset intervals, the program pops up and leads you through exercises that help you relax your eyes, neck, back, and wrists. 608-273-2739

Ergodyne, a maker of ergonomic office accessories, has also entered the exercise-software business with Windows-based *WorkSmart* stretch software (\$39.95). Every 50 minutes, the package uses animations to lead you through exercises for your neck, shoulders, upper arms, lower back, and legs. You can customize the program to focus on your personal trouble spots. 612-642-9889

AND FINALLY

The Internet has gotten a boost with the announcement that **Encyclopedia Britannica** will provide the full text of its flagship reference work on-line . . . **IBM Personal Computer Co.** has cut the prices of its ValuePoint PC models 19 percent across the board. . . . Through May 27, owners of **NEC Technologies'** MultiSpin 38, 74, and 84 CD-ROM drives can upgrade to NEC's MultiSpin 3X family of triple-speed CD-ROM drives for prices ranging from \$249 to \$309. . . **Matrox Electronic Systems** has cut prices on its MGA series of 64-bit graphics accelerators by 33 percent. . . **Broderbund Software's** wildly popular character, Carmen Sandiego, is now the star of her own Saturday-morning animated series on the Fox network. . . . Meanwhile, **America Online** announced that NBC Online will begin in May, enabling computer users to interact with a different kind of network. . . Registered users of **Microsoft** products can pay \$39 a year to join Microsoft Plus, a program that includes a bimonthly journal, express telephone tech support, product discounts, access to the Microsoft Plus Forum on CompuServe, and—we kid you not—a Bill Gates video.

ly derived conclusions to any problem that confronts you with multiple variables. Its key elements include the ability to handle an unlimited number of alternatives, evaluation measures, and goals (with five different weights that can be applied to each). You can compare inputs separately or in pairs, factor in uncertainties, and generate graphs to show you a goals hierarchy. It's a good tool, not only for analyzing all the possible permutations of a hard decision, but also for defending a decision once you've made it.

• List price: *Logical Decisions for Windows, Version 3.0*, \$395. **Logical Decisions**, 1014 Wood Lily Dr., Golden, CO 80401; 800-355-6442, 303-526-7536; fax, 303-526-7537.
Circle 417 on reader service card

NEW

cc:Mail on the Road

cc:Mail Mobile for Windows, from **Lotus Development Corp.**, vendor of the popular LAN based cc:Mail, is designed for users who leave the comfort of the network but want simple and familiar e-mail no matter where they're connecting from.

Mobile users tend to use multiple sites, and cc:Mail Mobile adds context-sensitive pick lists that let you create and save settings (each with its own icon) for many different dialing sequences including dial for an outside line, enter a calling card number, and even disconnect the call waiting.

Because the package supports regular modems; wireless connections (either via RAM Mobile Data Network or cellular phones); and many standard LAN protocols including IPX/SPX, TCP/IP, and ISDN, each session can also specify the type of connection you're trying to make.

cc:Mail Mobile also adds management functions targeted for the traveler. By creating filters for incoming transmissions, you can screen out unwanted e-mail and with a preview function see message summaries (including estimated transmission time), both these features mean minimized connect time. Management features for moving and copying messages to and from the network as well as a log to track connections that gets forwarded to an administrator for troubleshooting analysis. cc:Mail Mobile for Windows operates on a 286 or better processor with internal, external or wireless modem and requires 4MB RAM and 6MB hard disk space (10MB is recommended).

• List price: *cc:Mail Mobile for Windows*, \$195. **Lotus Development Corp.** 800 El Camino Real West, Mountain View, CA 94040; 800-448-2500, 415-961-8800; fax, 415-961-8400.
Circle 425 on reader service card

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T56h	17"	0.28mm	60/80/90Hz Vsync 50/60Hz	1280x1024
F780cW	21"	0.28mm	60/80/90Hz Vsync 50/60Hz	1600x1200
F760cW	17"	0.28mm	60/80/90Hz Vsync 50/60Hz	1280x1024
F560cW	17"	0.28mm	60/80/90Hz Vsync 50/60Hz	1280x1024
F550cW	15"	0.28mm	60/80/90Hz Vsync 50/60Hz	1024x768
F340cW	15"	0.28mm	60/80/90Hz Vsync 50/60Hz	1024x768

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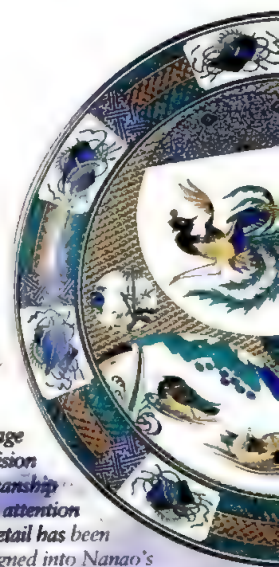
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Nanao monitors feature protective coatings and panels that reduce glare and eliminate static electricity.



Nanao was the first monitor company to join in partnership with the EPA Energy Star Program.



A heritage of precision craftsmanship and attention to detail has been designed into Nanao's family of display monitors.

Choosing a True Color Accelerator

It is no longer necessary to give up performance or high resolution to have rich photographic colors. Some valuable information to help you select a true color accelerator follows:

Performance = 64+24

True color (referred to as 24-bit, or 16.7M colors) requires a graphics board to process three to four times more information than it would for 256 colors. Fast 64-bit graphics chips with complete hardware-assist functions for 24-bit acceleration are best suited for fast true color use. Some accelerators offer only 32-bit graphics engines or limited 24-bit color drawing functions. When comparing graphics performance, be sure to ask your vendor for results in true color mode, not just in 256-color mode.

Don't Reboot Windows

Conventional 2MB graphics cards force you to choose between high resolution graphics at 1280x1024 with only 256 colors or true color with only 800x600 resolution. Since you can't have high resolution mode for detailed text work and true color mode for rich photographic colors at the same time, you have to compromise.

To switch modes, conventional boards require you to leave the application and then restart Windows. This process is inconvenient and time consuming. Look for features like ATI's WinSwitch, which allows you to quickly and conveniently toggle between high resolution mode and true color mode using a simple keystroke without closing your applications or leaving Windows.

VRAM Really Matters

Only VRAM memory guarantees stable performance in true color modes because of their dual port design. Most DRAM accelerators may look fast in 256-color mode, but will offer only a fraction of the performance of VRAM accelerators in true color mode. Avoid DRAM memory for serious true color work.

Watch for new helpful information.....

GRAPHICS AND MULTIMEDIA ACCELERATOR • GRA

Attack of the Killer Pixels



There's millions of them, and they're moving fast to infest every PC with deadly precision and terrifying speed. The hordes of killer pixels from ATI's GRAPHICS PRO TURBO will turn your PC into an amazing hive of graphics activity.

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Stirred up by our 64-bit *mach64* accelerator chip, the GRAPHICS PRO TURBO sends your applications swarming across the screen at fantastic velocities – over 100 million Winmarks*. Work faster not harder, even in demanding high resolution, true color applications.

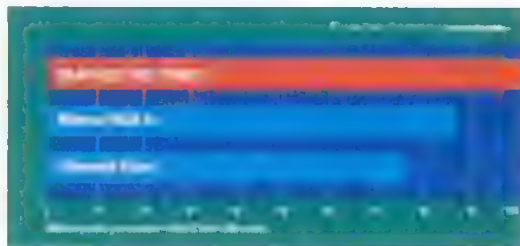
GRAPHICS PRO TURBO is the ideal card for today's hot PC architectures. With up to 4MB of memory for 1280x1024 graphics in



16.7 million colors, VRAM ensures consistent performance across all display modes. And unlike a lot of other accelerators, the GRAPHICS PRO TURBO is frantically fast not just in Windows, but in DOS and other environments as well.

True Killer Color

ATI's new strain of pixels is not only fast, it's vibrantly colored as well. GRAPHICS PRO TURBO gives you accelerated 24-bit true color that never stops working, even at resolutions as high as 1280x1024. In fact, it runs in 16.7 million



GRAPHICS PRO TURBO
outperforms other accelerators.

just 256. Our exclusive software keeps all that color under control. Color calibration software provides a perfect match for graphic arts applications. Plus



• 105+ Million Winmarks[†] • 1280x1024 in 16.7M colors

Introducing the

GRAPHICS PRO TURBO™

our unique WinSwitch feature lets you change color and resolution modes to suit your application requirements, quickly and conveniently ... without restarting Windows.

Wilder Windows

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Vicious Video
As an added bonus, the GRAPHICS PRO TURBO is ready to make motion video fly. With accelerated image scaling and enhanced pixel smoothing, it displays motion video with no additional multimedia hardware.

Bee The Best
Our high quality design ensures a perfectly clear picture ... no color bleeding or blurry images. And ATI's solid support, with regular no-bug software updates, will keep your system humming. So don't bee stung by lesser graphics. Get the GRAPHICS PRO TURBO. It's a honey of a card.

COMPLETE PERFORMANCE DATA (Larger numbers are better)

	ATI MGA II+	Matrox MGA II+	Diamond Veer
3D WinBench	36.2	28.0	20.0
2D WinBench	25.7	12.1	4.6
Pixel Fill Rate	8,482	993	2,953
Texture Rate	24	11	13

GRAPHICS PRO TURBO
outperforms other accelerators.

GRAPHICS PRO TURBO

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* All performance tests done on a Pentium 66MHz, 16MB RAM, 256K cache, 200MB HD at 60Hz, using 2MB versions of PCI graphics cards. † WinBench 3.11 at 1024x768 resolution in 256 colors
†† VGA performance tested using PCbench 7.01 (video harmonic) ††† Motion Video performance measured under Windows using 65K colors. Test clip recorded at 320x240 at 30 fps using Indeo codec.

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CIRCLE 127 ON READER SERVICE CARD
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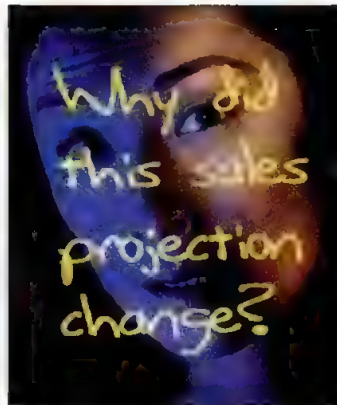
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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

Have Modem, Will Travel, But Not Without a Guide

BY CHARLES TAFT

Any seasoned traveler knows that a good map and guidebook are essential keys to unlocking the mysteries of cities. The same goes for the on-line adventurer. Without some well-written, easy-to-follow reference tools, you can quickly become frustrated and find yourself lost in cyberspace. Fortunately there are several books that can help you navigate the ether.

Beginners seeking guidance to the world of bulletin board systems will find in John Hedtke's *Using Computer Bulletin Boards* a gold mine of information. The first half of this clearly written book takes you through the BBS labyrinth and explains how to log on to a typical BBS; navigate through the features and conferences; send and receive messages, files, and programs; and explore conferences and doors.

The second half of *Using Computer Bulletin Boards* is for more-advanced users. It includes an introduction to (and screenshots of) various BBS software, including Fido, PCBoard, and Wildcat!. This half also provides information about on-line services such as CompuServe and Prodigy.

This comprehensive book also includes a section that shows you how to set up your own BBS. To help get you on-line and immersed in cyberspace, the book includes a 3.5-inch disk with the QModem 4.5 Test Drive communications software.

If you would like to communicate anywhere in the world for the price of a local phone call, you'll appreciate *Free Electronic Networks*. This guide to the Echo Nets introduces you to the people and the technology of bulletin board systems, gives tips for choosing communications programs and off-line readers, and offers comprehensive listings of bulletin boards (including telephone numbers and conference topics). An excellent introductory

book for people who want to communicate on Prodigy and CompuServe is *Exploring the World of Online Services*, by Rosalind Resnick. It offers sound advice, clear directions, and helpful screenshots. Taking the beginner from step one, the author gives an overview of these on-line services and explains how to use modems and communications programs. Resnick also suggests practical ways to keep costs down (such as using pay-as-you-go plans and off-line readers like WinCIM). She shows how to post and reply to messages, access forum libraries and databases, communicate



overseas, use financial services, do on-line comparison shopping, and try myriad other services.

• **Using Computer Bulletin Boards (Second Edition)**, by John Hedtke, \$29.95. MIS: Press, 800-628-9658.

ISBN:1-5828-196-7.

Circle 481 on reader service card

• **Free Electronic Networks**, by William J. Shefski, \$24.95. Prima Publishing, 800-255-8989. ISBN: 1-55958-415-7.

Circle 482 on reader service card

• **Exploring the World of Online Services**, by Rosalind Resnick, \$17.95. Sybex Inc, 800-227-2346. ISBN: 0-89588-798-3.

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Read Only Recommends

Here are five other books to help both neophyte communicators and cyberspace jocks find what they need on-line.

One of the more complete, well-organized guides to on-line topics is *Net Guide*, which contains listings of more than 4,000 special-interest forums available on CompuServe, GENie, ILink, and the Internet. The topics are grouped by category (such as arts and entertainment, business and finance, lifestyles, and leisure and travel). If you're looking for forums on topics ranging from photography to the Church of Elvis, you'll find them here.

One of the better how-to books is *The Online User's Encyclopedia: Bulletin Boards and Beyond*. In encyclopedic fashion, it discusses everything

from purchasing a modem to saving money on your phone bills and has clear definitions of a multitude of topics. Another fine book is *Modem USA*, which has numerous topics listed by state. For a worldwide view of on-line services, turn to *The Whole Earth Online Almanac*.

For bibliophiles and researchers who need to consult listings of the Library OnLine Public Access Catalogs and Databases, the *OPAC Directory 1993* has information about almost 300 library catalogs, including catalog statistics and dialing instructions.

• **Net Guide**, by Michael Wolff and Peter Ritten, \$19.00. Random House Reference and Electronic Publishing, 800-733-

3000. ISBN:0-679-75106-8.

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• **The Online User's Encyclopedia: Bulletin Boards and Beyond**, by Bernard Aboba, \$32.95. Addison-Wesley Publishing Co., 617-944-3700. ISBN: 0-201-62214-9.

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• **Modem USA**, by Lynne Motley, \$24.95. Allium Press, 202-291-8941. ISBN: 0-9631233-6-X.

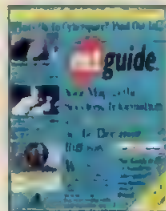
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• **The Whole Earth Online Almanac**, by Don Rittner, \$32.95. Brady Publishing, 800-428-5331. ISBN: 1-56686-090-3.

Circle 488 on reader service card

• **OPAC Directory 1993**, compiled by Regina Rega, \$60.00. Meckler Corp., 800-632-5537. ISBN: 0-88736-883-2.

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How to stop these little things
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Introducing genuine IBM peripherals. For genuine non-IBM PCs.



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can take her entire computing environment on one little drive. No bulky hardware. No leaning tower of floppies. She simply plugs her *MobileMax* drive into any Type III PCMCIA slot. And if she meets a computer without a slot, a *MobileMax* DeskRunner™ reader/writer from Maxtor provides full PCMCIA capability. Incidentally, Dr. Robinson isn't the only one concerned about prolonging life. *MobileMax* drives use

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CIRCLE 386 ON READER SERVICE CARD

"What to do when Windows™ won't work."

INCREASE SPEED

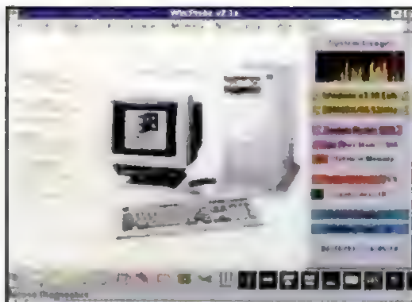
WINProbe uncovers the secrets to faster Windows operation. Simply click your mouse on "Tune Up" and **WINProbe** analyzes your system, then gives you up to 35 suggestions on how to speed up your system...

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- Keyboard and scan codes
- Video adapter and screen
- Mouse initialization and interrupts
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Windows Sources

"A bargain worth writing home about."

PC Computing

"WINProbe's most impressive offering is its memory-reclamation capability. This feature alone is worth the price of admission."

PC Computing

RESOLVE SETUP PROBLEMS

Say 'goodbye' to software and hardware configuration and setup problems. **WINProbe** provides helpful information on...

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- CMOS display and edit
- IRQ, DMA, and UMB usage
- What to do when installing an add-in card
- Cleaning up *.INI and *.GRP files
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CIRCLE 169 ON READER SERVICE CARD



Michael J. Miller

The Myth of Usability

Lately, we've been hearing a lot of software companies talk about "usability" as if it were the new Holy Grail. While I have no doubt that this emphasis can and will lead to better, easier-to-use software, I also have no doubt that the term is being used more for

marketing hype than for actually making software better. Part of the problem is the term itself. Software developers talked about "ease of use" for years before "usability" became fashionable. That's because we have all complained that software has been too difficult to use. Remember Software Publishing's "Power-Easy" positioning, Microsoft's "Making It Easier," and Borland's "Power Made Easy" slogan?

Virtually all successful software is easier to use now than it ever was before. So why has usability suddenly become so important an issue in software marketing?

WHY NOW?

We've passed the point where most software can compete on what it can do. All of the name-brand word processors, spreadsheets, databases, and graphics packages do so much now that most people don't want more new features. Instead, they want the features they already have to be easier to use.

Today, much of the new horsepower provided by 486- and Pentium-class machines is being put to work to try to achieve that goal. This makes computers practical for more and more people, who want to spend as little time as possible learning how to use software programs.

At the same time, several software developers have discovered the benefits of usability studies. Typically, these studies are done in special rooms with one-way mirrors, either at the developers' site or at a company that specializes in usability tests. Test subjects come in and run through a series of tasks, while the developers of the software watch them through the mirror and monitor their reactions.

This type of examination works best when software developers watch to see whether the test partici-

pants can easily understand the user interface and the on-screen instructions. After all, seeing exactly where potential customers have trouble understanding what to do is much more effective than simply hearing how difficult it is from a technical-support line, a written review, or an on-line forum.

In many cases, these tests have led developers to try to figure out new and better ways of taking customers through their programs. This is exactly where usability studies are most useful, and it's the reason you see usability centers popping up at firms like Microsoft and WordPerfect. Companies like Lotus are using third-party usability test centers.

While all this work on usability is wonderful for software users in the end, there is still something about it that worries me.

MARKETING PLOY?

Here's my problem. Sometimes, software developers use usability studies to present a marketing case that claims one product is easier to use than another. This often results in advertisements that shout, "Four out of six users of Product A prefer Product B."

This may sound very impressive, but be careful of the fine print. In one case, a third-party company did a usability test for the makers of Product B. Six people happened to be users of Product A, and at the end of the test, four of them said they preferred Product B. In percentages, this would sound great for the makers of Product B, but is it representative of what most users would think? I wonder.

First of all, six people may be enough to find usability problems. But six people are not enough to let you make valid predictions



Ease of use is hardly a new idea, so why is there so much talk about it these days?



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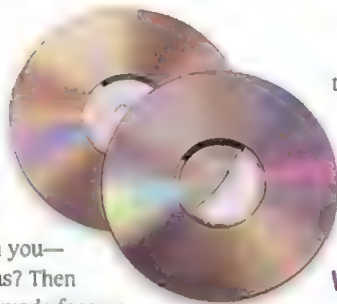
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Ready for a Windows workstation that's fast enough to keep up with you—and multiple applications? Then the AcerPower series is made for you. Real power-users wouldn't settle for less than the screaming 32-bit processing power, integrated CD-ROM drive and VESA local bus accelerated graphics featured in the AcerPower line. And don't worry about the system



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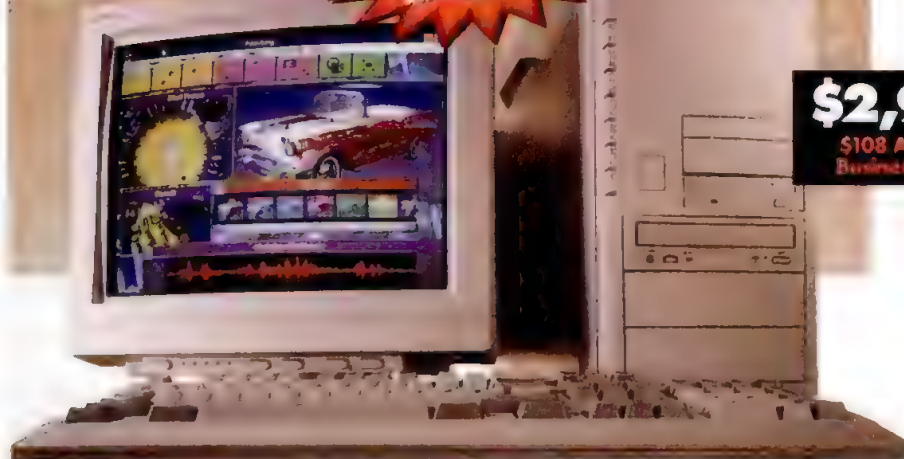


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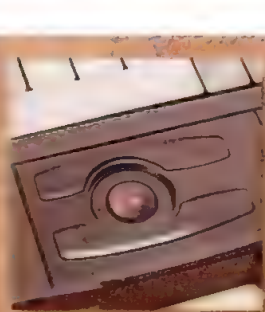
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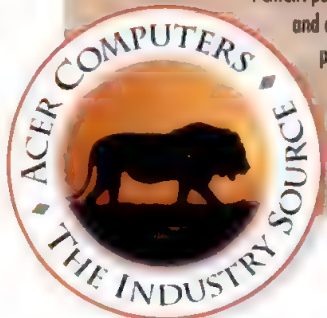
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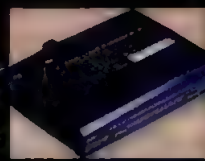
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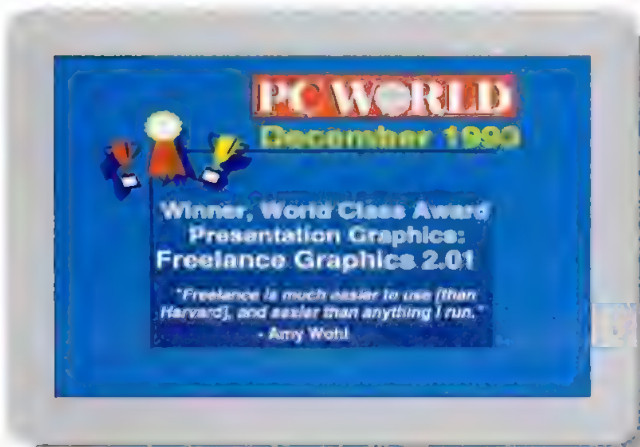
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Bill Machrone

Distracted by Something Shiny

User interface designers treat us like ninnies. They're inventing user interfaces for the rest of us, they say. But with half the population already using personal computers, "the rest of us" is a rapidly diminishing market. I get really cranky on this

subject, but there's a lot at stake here. UI designers make three assumptions, all of them false:

1. Pictures communicate more powerfully than words. Designers are still very much in the grip of icon mania, even when the icons do nothing to enhance understanding or ease of use. Have you spent any time with Creative Writer yet? Microsoft's new word processor for kids is the product of the most intensive research into user interface issues so far. Using young kids as a target market means that you get a lot of people who have not yet learned any bad user interface habits. Creative Writer is replete with icons. It hardly uses any words at all. As a result, you have to learn the symbology before you can do anything useful with the program. The first menu, for instance, is a big capital A with a paintbrush. It contains all the goodies you'd usually find under the Format menu of most word processors. You can dope out most of the icons, but what are you to make of an arrow going into a paint can? It turns out to be the Dunker, which applies a change to everything at once. And what are you to make of the next icon, a woman with a huge nose? She's Mona Weasel, and she's the mistress of all clip art in Creative Writer. The dog icon on her submenu? That's Ratdog, which retrieves graphical images for you.

Is this easier to use than buttons that say Words, Pictures, and Find? Evidently not. My son Andrew, age 8, was working on his science fair project and wanted to produce some text and graphics. He was enthused about using Creative Writer at first, but found the menus frustrating in their lack of guidance. He wanted landscape output, and after he finally found it, the program refused to accept his choice. After fruitless trips to the help menus, he asked if we could use Microsoft Word instead. Both of us failed to understand how pictures are

superior to words for someone who can read and write.

One of the most significant findings to come out of all of Microsoft's research is that kids prefer a way of manipulating the objects on the screen that's different from what we're used to. Traditional Windows and Macintosh programs are arranged in noun/verb format: You select an area of text or an object, then you choose an action to perform on it. Microsoft's hundreds of test subjects preferred the opposite: You choose a tool, then drag it across the object. Granted, some applications—especially paint programs—use a noun/verb format, but that just exemplifies the inconsistencies in today's interfaces. Microsoft has been touting this discovery as revolutionary. Ironically, Doug Engelbart (the inventor of the mouse and the graphical user interface) and his fellow researchers at Stanford Research Institute came to the same conclusion—in 1968.

2. We have entered the postliterate age. Beyond the words-versus-pictures debate lies the larger issue of how images are presented. Designers take it as a given that we want pictures to accompany our words, and if those pictures are gyrating with coruscating colors and pulsating sound, so much the better. Arcade games and slot

machines are noisy. They flash their lights and play their come-hither songs in the hope that you'll come over and drop in a quarter. What do they think we are, magpies? Laurel Clarke, an on-line friend, expresses it well: "Running like crazy . . . till I get distracted by something shiny." Maybe we all feel that way from time to time, but that's no reason for manufacturers to rub our noses into it by putting this junk onto our computers or video games. Do we need to be seduced by our own tools and entertainment devices?

Then there's the MTV

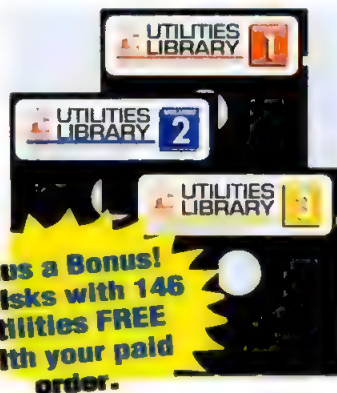
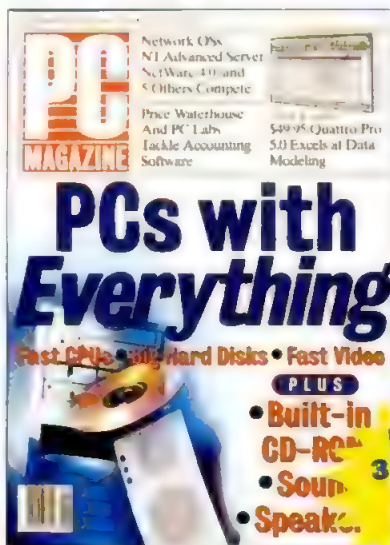


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Bill Machrone

aesthetic. MTV is the apotheosis of postliterate entertainment, but it's getting serious competition from the six o'clock news, complete with its own contribution to postliteracy, the sound bite. Both formats keep flashing the shiny somethings before our eyes to get and keep our attention. Multimedia computers have made it easy to incorporate this junk into programs, and we're subjected to countless splash screens with animation and sound. Imagine if the icons on your screen all competed for your attention: Ami Pro might wave cheerily; Excel would give you a sly wink. Colors would change constantly; guitar and synthesizer riffs would punctuate every movement of the cursor.

My fervent plea to the designers: Please don't mistake my computer for a television set.

3. Users are couch potatoes at heart. First there were general stores. Then department stores. And strip malls. Then home shopping. Now we face the prospect of computer shopping to brighten our future. No, not shopping on our computer screens—our computers do the shopping for us. This is the underlying stratagem of General Magic's Magic Cap and Telescript. At its heart, Telescript is networking software. Applications act as agents: they distribute themselves as needed over the network in order to get our job done.

Let's say you want a new VCR. You click on the Sony store on the screen (no one knows why it's better to click on the store than on the word *Sony*, but we've already been over this) and get specifications on VCRs. Once you find one you like, you can decide how much you want to pay for it. Your agent, in the form of a Telescript program, sets itself up on various retailers' machines and watches sale prices. When one comes within your range it completes the transaction.

Will "visiting different shops" be an acceptable form of computer intercourse? Shops will open their doors to your bodily presence, but will they allow your agent to come in and shop for you? And how much CPU power will the store need in order to support all those agents waiting for a markdown? If shopping were all about price, this might be an interesting approach. It currently helps travel agencies get the best deal on airline tickets. Program trading drives the stock market, too. But I'm waiting to be distracted by some retailer's shiny object. □

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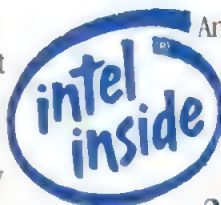
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John C. Dvorak

The Upgradability Scam

I do a lot of public speaking on the latest and greatest trends to hit the computer industry, and recently I've been finding that corporations want someone to prognosticate, to straighten out all the confusion. I predict that if the confusion gets any worse, the

industry will go into a tailspin as big corporations hold off purchases and wait it out as they would a passing storm.

There's concern over whether to delay all purchases of all equipment in case the PowerPC becomes the new standard. And there's enormous concern over Microsoft's shotgun approach to operating systems marketing. Is a corporation supposed to buy into the Windows NT schpiel? Or just use plain Windows or Windows for Workgroups? What about Chicago? Should a business cease all purchases until Chicago is released? And *when* will Chicago be released? Everyone wants to know.

In the background looms still another Microsoft promise: the object-oriented operating system dubbed Cairo. And what about the new Windows NT dubbed Daytona? And what's this thing called Snowball? If Microsoft can't focus on one thing, how can anyone figure out what to do? This isn't leadership, it's nuts. And did anyone notice the ridiculous numbering scheme for DOS? First Microsoft releases DOS 6 ahead of IBM to get an edge. Then IBM offers DOS 6.1. Microsoft fixes a few bugs in DOS 6 and calls it DOS 6.2. IBM fixes its bugs and calls it DOS 6.3. Gee, the higher the number, the better the product, right? Give me a break.

Then we have the proposed Plug and Play standard. Does anyone know what this really means for the user who has a shop full of 486DX2/66s? I sure don't. Can you replace the BIOSes on all those old machines? It's unlikely, but who knows? And where does the battling and bickering between the proponents of the PCI bus and the VESA VL-Bus leave the users? Will Intel ever stabilize the PCI bus so we can rely on it? Or do the VESA people have a legitimate performance argument? Can both systems coexist?

Attempts are under way

to calm this fear-driven market. First, there are plenty of bogus claims about upgradability. Vendors hope to assuage the hapless buyer who's scared witless over the prospect that his or her machine will be outdated a month after it's purchased. Of course, if the whole business community shifted to the PowerPC, these upgrade sockets won't offer much solace.

The upgradability phenomenon occurs each time we adopt a new chip. In the past, it surfaced as a complete computer on a card such as the SOTA or Quadram 86, each of which slipped into a slot on an old 286. More recently, it's been 486 daughterboards and the nifty Cyrix 486, which is pin-compatible with a 386. Now it's these sockets. Add the Cyrix 486 and your 386 runs faster but is unlikely to have a VL-Bus to speed up the graphics. Buy a machine with a socket, and how will that get you the next generation of PCI-bus? Upgradability speeds up an old machine but doesn't modernize it.

These upgrade problems can be solved, but nobody wants to pay the price. One possibility is to dump the motherboard architecture and adopt a card cage architecture where the processor card is easily swapped out, just like a disk controller card or a serial device card. Of

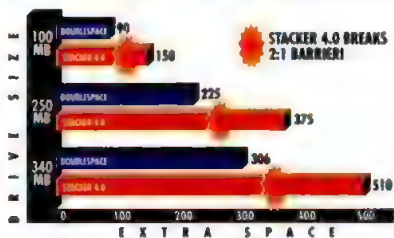
course, this would cost two or three times as much as the integrated motherboard. So let's forget this idea fast.

Already some observers are sensing a conservative approach toward upgrading. The reason the small-office/home-office market is blossoming is that small-office buyers can afford to be wrong with their purchasing decisions. Having one or two white elephants is a lot easier to bear than having 10,000 dead-end machines. Once things stabilize, you'll hear little about the home-office market. Just wait and see.



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Inside Track

T

he Plot Thickens Dept.: As I write this, Intel has settled with Cyrix and agreed to let **IBM increase production of the 486.** I suspect Intel is going to allow IBM to sell **raw chips**, not just motherboards. A recent deal drawn up between the

two companies seems to be part of a grand scheme. Actually, two grand schemes. One dreamed up by Intel, the other by IBM. This is open to interpretation. Here's mine.

When Intel pulled back on **litigation** with Cyrix, I figured something was up. Intel loves to litigate. The only reason it would pull back is to begin to **open the floodgates**

of 486 production. Let everyone make them. Flood the market with 486s and then up the ante with faster Pentiums later this year. Intel has a clear monopoly on the Pentium. So where does IBM fit in?

IBM and Intel have had this **low-level feud**. They compete on the serious-money level: making computers. It seems that clone makers are now having **Intel make their entire machine**. Intel is cranking out boxes while vendors simply add their own labels. We're talking **millions of machines**. Whom does this hurt most? Let's say IBM.

Part 2: Compaq made a big announcement that it will begin to use AMD chips. Intel holds such an **axe over everyone's head** regarding second-source suppliers that I don't believe for a minute that Intel didn't approve the Compaq announcement. Why? Because it hurts IBM.

Why hurt IBM? Because with its PowerPC, IBM is a serious threat to Intel and the only company left with an **iron-clad license** to clone Intel chips. IBM knows that it can't forever battle Intel by playing the "let's clone an Intel chip" game. So for the short-term benefit of making and selling more 486s than allowed by the original license, **IBM renegotiated** and gave away its rights to clone the Pentium. This wasn't dumb, but it was a **gamble** and it means the battle lines are drawn.

IBM figures it can gear up the PowerPC machine and **end-run Intel** before Intel's newest Pentiums grab the market by the gonads and keep it firmly entrenched and headed toward the P6. Intel knows what IBM is up to and figures it can beat Big Blue at this game. After all, who's better at **controlling the destiny** of the desktop computing market than Intel?

I'm convinced by talking to IBMers that the **secret plan** at IBM is to milk the 486 for all it's worth and incorporate the 486 chip into the personal PowerPC machine

According to Silicon Valley sources, IBM is planning to steamroll the industry with inexpensive PCs, forcing all the weak sisters out of business in a bloodbath. The industry is in for a rude awakening.

to be introduced later this year. If IBM can keep the price low enough, the new architecture can grab momentum and be compatible with 99 percent of the applications now shipping.

It gets weirder. Unbeknownst to Intel, IBM also needed to make a deal with Intel regarding the 486 because, according to Silicon Valley sources, IBM is planning to **steamroll the entire industry** with new low-ball pricing on a new line of ValuePoint 486 machines. I'm told that IBM planned to announce the new line of incredibly inexpensive machines at the CeBIT show in Hannover in **March**. The company will **crank up production** and, like a Sumo, use its much-maligned, massive size to force all

the **weak sisters** out of business in a bloodbath. If the plan is anything like the one outlined to me, then the industry is in for a rude awakening. If Intel is making as many boxes as I'm told, then it's **in for a surprise**, too.

IBM's long-term strategy is to grab market share then **move the customer base** to the PowerPC machine. Interesting concept if it works. The drawback is that IBM's own bureaucracy is messy. Someone may **futz around** and introduce a flaw. I'm betting on the flaw.

Chicago, a Toddling Town Dept.: Chicago is the code name for Microsoft's newest 32-bit version of Windows (also known as Windows 4.0). It's **supposed to come out in 1994**, but I suspect 1995, with some sort of Windows 3.5 upgrade in 1994 to generate cash flow. According to people who have the Chicago beta, there's some **dubious news**. It will require a 4MB system, which should be no big deal by the time it arrives. Unlike NT, it will **not be a Unicode** operating system as promised. And the "not like NT" theme runs throughout the product. The list of NT features and Chicago features makes it look like the two programming groups never talked. More important, the **rumor** is that **Microsoft is going to change the graphical user interface** to something more like OS/2 or the Mac! You know: a desktop metaphor with lots of folders you can embed in other folders.

The muckamucks at **Microsoft** are aware of the **alienation** that an abrupt GUI change might make, so they're looking for alternatives. Surely, Microsoft doesn't want to make the operating system look anything like OS/2's Presentation Manager. **How embarrassing** for Microsoft. The talk is that it's experimenting with **odd metaphors** such as a living room and an airplane cockpit. One person says that you'll get to **choose from a variety** of GUIs, including one that's a clone of The Norton Desktop for Windows. It's nuts. □



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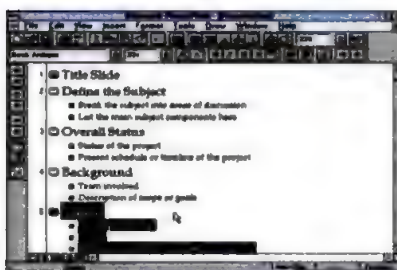
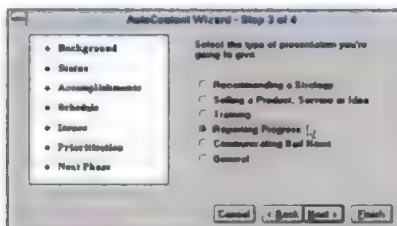
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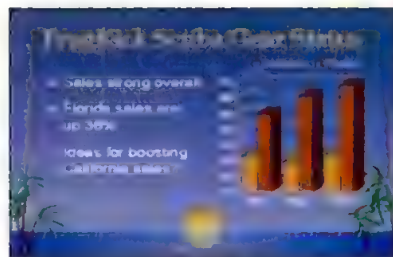
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Jim Seymour

Will the ISH Be a One-Way Street?

I don't know about you, but I'm just about ISHed out. The endless drumbeat of cutesy speculation passed off as reporting and analysis on the proposed Information Superhighway has gotten pretty tiring. I'm not saying that the ISH isn't a good idea; it is,

and it's coming, and that's a good thing. But both the terrible, wildly overused freeway metaphor and the nonsense it invites are really grating.

"On-ramps to the ISH," "off-ramps on the ISH," "toll booths on the ISH," "highway cops on the ISH," "speed limits on the ISH," "fast-food joints for the ISH," "hailing a taxi on the ISH," and "U-turns on the ISH" are just a few of the dumber clips I've tacked up lately on the ISH Wall of Shame in my office.

Ken Wax, a marketing consultant, got off the only good ISH pun when he wrote recently in *Advertising Age* about the uninformed victims of all this hoopla: the "road kills on the ISH."

And Dick Cavett nailed it at a UCLA ISH conference: "The 'information superhighway'? That sounds like a place that's long, boring, and kills 50,000 people a year."

The real problem with the information superhighway metaphor isn't just that it's clunky, or that it has been so grossly overused: It's that a superhighway is a lousy model for a national interactive data system.

Not to worry, you say? This information superhighway cliché is only headline-writer talk, a passing fancy among those who thrive on the latest cocktail-party chatter? Ah, if only that were so; if only the real sin here were against the language, not against the millions of us who'd like to use a well-conceived national information network. Because of one of the odd twists of language and usage, we sometimes let metaphor take over meaning. When we're seduced by a clever and appealing metaphor, instead of letting the idea define the metaphor, we often turn it around so that the metaphor defines the idea.

That's what's happening with all this information superhighway nonsense.

The ISH metaphor describes a flat, two-dimensional model for information exchange. What we really need for a national information infrastructure is far richer: a complex, three-dimensional, and fully interactive model, not a spiderweb of wires designed mainly to ship the digital equivalent of truck freight (movies on demand, for example) to your door.

But if we're subjected to much more of this ISH stuff, we're all going to be so confused that we'll start calling anything that Washington comes up with a good plan. And history suggests that would be a mistake.

I can't overemphasize the importance of a two-way, truly interactive design for the national network (which, it seems, is a vastly better and simpler phrase than *information superhighway*). Yet the plans currently being discussed on the primitive ISH model may not deliver that full two-way bandwidth to your den and desk or to mine. Especially if the planners follow the path of least resistance, also known as More of the Same, but a Little Faster and Better.

WHOSE CARRIER OF CHOICE?

In this Age of Convergence, the phone companies and the cable-TV companies are playing cobra and mongoose to see who gets to deliver the most digital services to your door. Both are now rewiring parts of their systems with optical cable in order to increase bandwidth and then claim carrier-of-choice status for your access to a national network.

It seems logical that the telephone companies will win this contest: After all, they provide the links most of us now use to access everything from CompuServe to the Internet, to say nothing of all those voice calls and faxes zipping around out there somewhere.



The information superhighway is more than just a bad metaphor; it's a bad model.

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Jim Seymour

But which of these kinds of companies has the best connections to your home already in place? Arguably, it's the cable companies, with coax cable (or better) reaching right up to your door—which in turn connects to the coax cable already in your walls.

Would you rather rely on the phone companies' weak-link copper pairs running to your door or the cable companies' far-superior coax? Even if Mr. Telco were to provide a higher-bandwidth drop to your door, are you ready to rewire the inside of your house to exploit that wider signal path?

SEND AND RECEIVE

And in *any* of the models currently being discussed, is there any assurance that we'll have the same end-to-end system capacity for sending as for receiving? Some information superhighway gurus say we won't need all that bandwidth from our end to send information out our doors; we'll need just the high-bandwidth pipeline to deliver data to us.

Excuse me, but that ain't interactive. That kind of thinking is based on all these movie-ordering, TV-set-top boxes Microsoft is supposed to provide, where we beep in the number of the movie we want to see at 9:21 tonight. What about our ability, for example, to be part of live, multipoint, full-screen, full-motion, color videoconferencing? Does anyone seriously think that's not going to be part of our midterm digital future?

We need a first-class national network, one that is based on a realistic mix of currently available technologies and connections. And we need a national network that is truly duplex, with identical bandwidth all the way, both ways, from our homes' wiring through cabling, gateways, intervening switches, and uplinks and downlinks right up to those amazing new video servers and anything else we want to connect with.

We're not going to get that if we default to a limited information superhighway system designed with a lot more attention to deliveries than to pickups.

This idea is too important to leave in the hands of sloganeers and politicians. We just can't allow such an important notion as the ISH to become another IShtar—a road show that doesn't work. □

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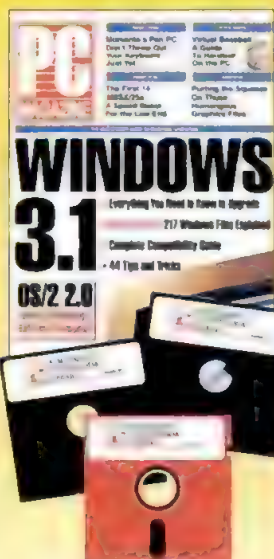
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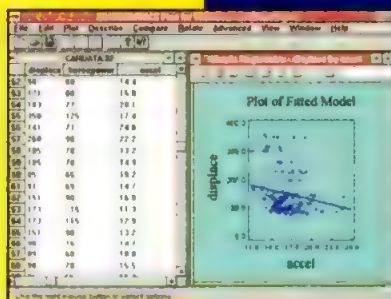
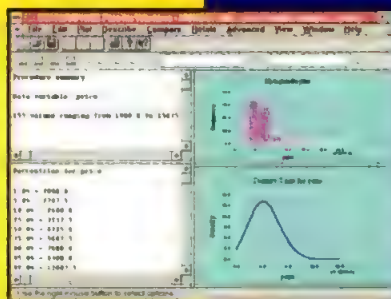
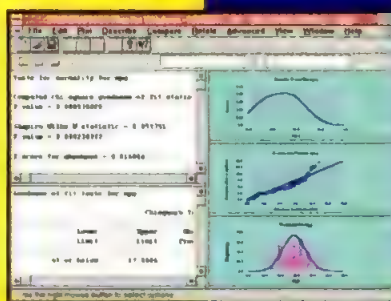
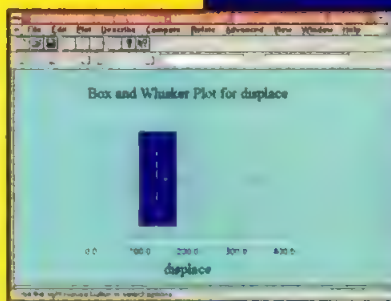


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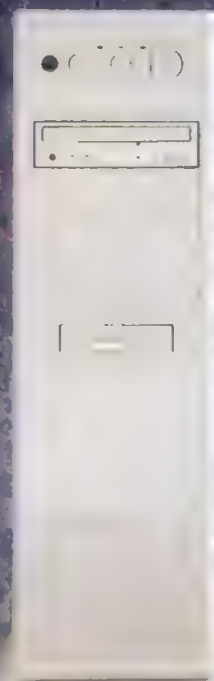
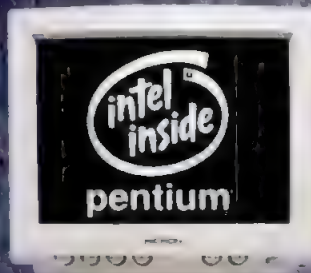
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CIRCLE 119 ON READER SERVICE CARD



Bill Howard

Do You Hear What I Hear?

We continue to be amazed by the not-ready-for-prime-time nature of sound boards. Elsewhere in this issue you'll read evaluations of 24 sound boards theoretically capable of recording and playing CD-quality audio. When we listened

closely or turned up the volume, however, we found the sound quality mediocre. That is, it was mediocre once we got the boards to work. Some vendors had to send second or even third boards before we got one running.

If you've got relatively deep pockets, you're in luck. You can buy the Turtle Beach MultiSound or its successor, the Monterey MultiSound, and get sensational audio quality. A year ago these boards listed for \$599; now they're \$399, which is high but no longer outrageous. Don't be swayed by reviews you may read elsewhere that say the MultiSound boards need specially powered microphones. Though it's true, we found impedances with many other sound boards' microphone jacks, so in a sense you need special mikes for them, too.

Virtually every other board we reviewed forces you to make some kind of compromise. Given that most everyone wants a sound board that sells for less than \$200—and the good news is that the price of acceptable boards will move closer to \$100 over the year—here's what I'd do.

Consider making some trade-offs between ideal sound quality and ease of installation. In my case, I want business audio at the office, but at home with my kids, I'm more interested in playing video games with sound than composing a symphony. So if Roger Rabbit's voice is off by a hair, it's no big deal.

This leads you to the Microsoft Windows Sound System and its idiot-proof installation, although it lacks the proper connector to bring in audio from an internal CD-ROM drive. That means you can't easily play music CDs through your PC, nor can you play some edutainment titles that output analog sound (you still get the digitized sound), including Microsoft's own Multimedia Beethoven. Doesn't the left hand know what the right one's doing in Redmond?

If what you really want is good MIDI sound, I'd look for a board with sounds stored in wavetables rather than recreated through FM synthesis. Some boards let you add wavetable modules later, but it can be more costly that way. Other boards keep wavetable information on the hard disk, which is cheaper than keeping it on ROM chips.

You'll also find that boards with digital signal processors can speed up sound processing, a big help on slower PCs. But some boards with jack-of-all-trade digital signal processors (DSPs) that double as modems or answering machines might also double your installation hassles.

The surest way to eliminate installation hassles is expensive: Move up your plans to replace your PC and order the new one with sound and a double-speed CD-ROM drive installed. For business users, Compaq's integrated Business Audio (essentially the Microsoft Windows Sound System put on the motherboard) is a good deal. Watch for some stunning business audio ease-of-use improvements this spring. For existing systems, the only thing simpler than Microsoft's board is an external device that connects to the parallel port, such as the Logitech AudioMan.

If you're looking to record voice-only material, the TrueSpeech compression scheme, developed by the DSP Group, is available on the Microsoft Windows Sound System. It works on a few other boards, too, and provides exceptionally clear quality, yet 15 minutes of sound take up less than 1MB of space. You can buy the Windows Sound System software to run on other sound boards, which gives you TrueSpeech (good) but in some cases disables a board's special features, such as its DSP (not so good). One step forward, one step back. □



Sound boards are becoming less expensive, but watch out for the sacrifices that some of them demand.

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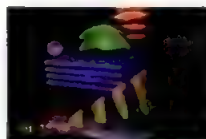
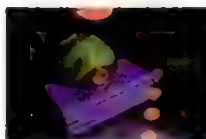
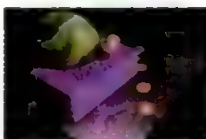
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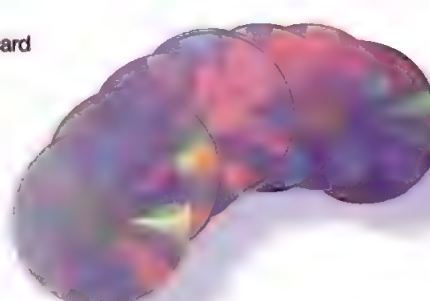
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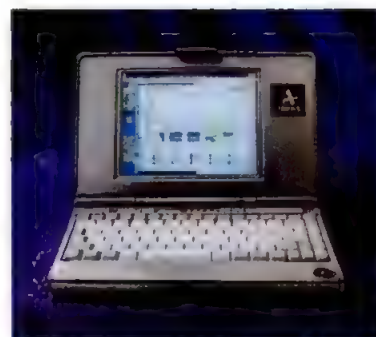
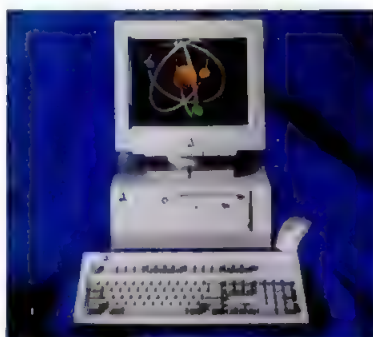
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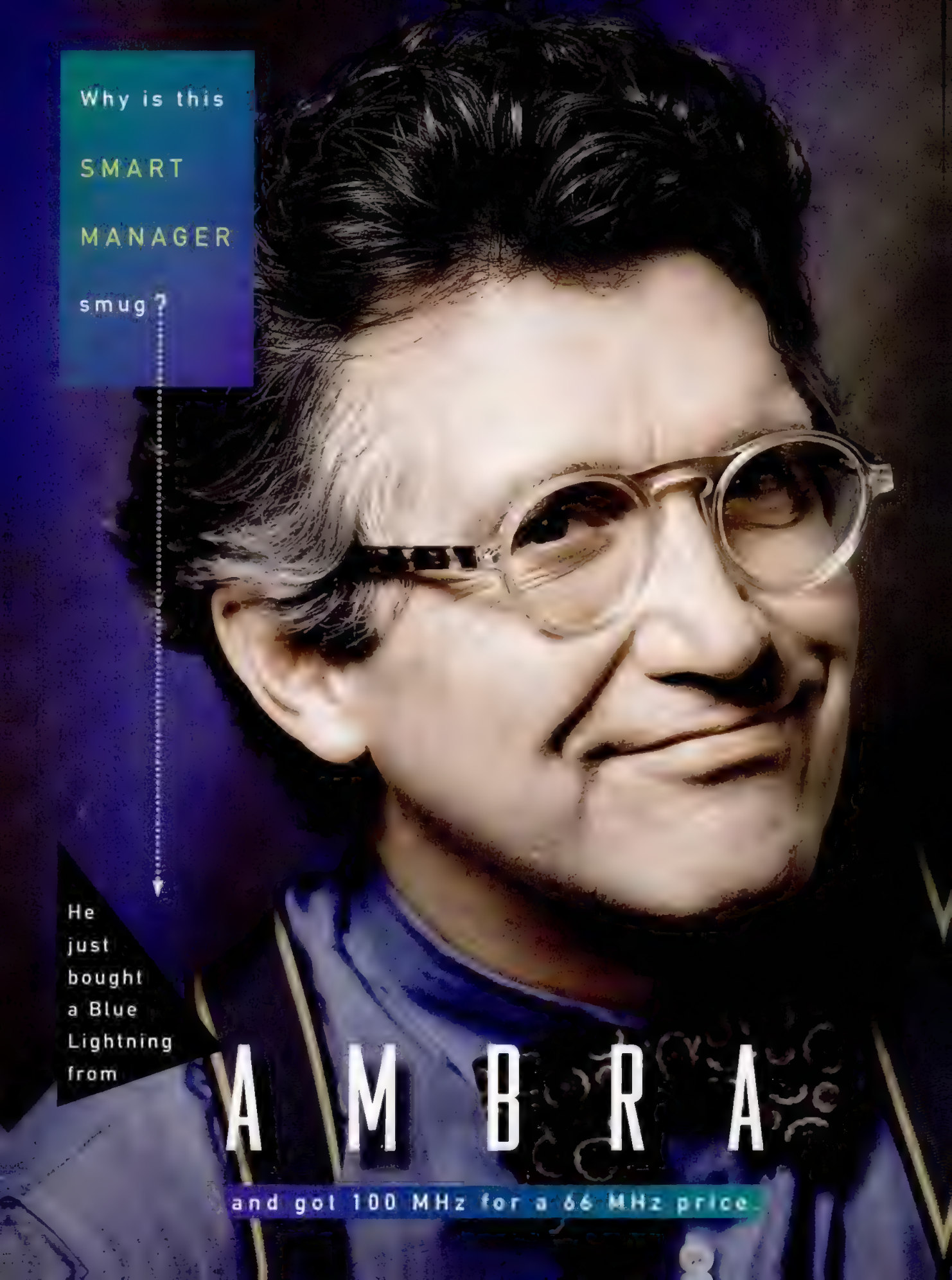


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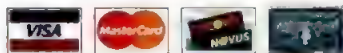
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STATE-OF-THE-ART PCs

Unleashing *the* Power *of* Pentium

Pentium with local bus technology is rapidly becoming the power user's system of choice. *PC Magazine* tests 31 systems that put data on the fast track.

Are you dying to get your hands on a Pentium-powered PC but don't think you have a wallet quite fat enough? Take heart, for a variety of Pentium PCs are now available at less-than-high-powered prices. With 6 million Pentium-powered systems expected to be sold this year, this zenith of PC power is rapidly becoming a mainstream computer.

The price of a Pentium system has spiraled down from the stratosphere to less than \$3,000. No, \$3,000 isn't chump change, but neither are these stripped-down systems. This is a realistic price for a real-world

PC that can fly through Windows applications about twice as fast as a 486DX2/66 system.

Just one year ago, ownership of a Pentium machine was the ultimate status symbol of a PC addict at the top of his or her game. Smaller PC vendors found that the ability to get Pentium chips was an indicator of their status.

Priced thousands of dollars above comparable 486DX2/66 systems, Pentium PCs were only for affluent power mongers or the vain. Not anymore. Thanks to the increased production of Pentium chips and to competition from powerful RISC processors like Digital Equipment Corp.'s Alpha and the PowerPC



chip developed by Apple, IBM, and Motorola, the price of Pentium power is now within reach.

What a difference three months make. In our roundup of Pentium PCs in the issue of January 25, 1994, the lowest price was \$3,595, for the Gateway 2000 P5-60 with a 60-MHz Pentium, 425MB hard disk, 16MB of RAM, double-speed CD-ROM drive, and high-resolution 15-inch monitor. By contrast, the very same Gateway model in this issue's roundup—now with a 540MB hard disk—tied the Austin Premier P5-60 Desktop (60-MHz Pentium, 424MB hard disk, 16MB of RAM, double-speed CD-ROM, and com-

parable monitor) at the bottom of the price scale with a cost of \$2,795—an \$800 price drop. A comparably equipped 486DX2/66 PC would cost about \$2,100.

REVIEW CRITERIA

For this roundup of today's fastest desktop computers, we asked for PCs with Pentium CPUs and the following minimum requirements: 16MB of RAM, a 300MB hard disk, a local-bus SVGA graphics system with a 15-inch monitor, a 1.44MB floppy disk drive, and a CD-ROM drive; we also requested that DOS 6.0 and Windows 3.1 be installed. The 31 PCs we

By Robert S. Anthony



EDITORS' CHOICE

received ran the gamut from small, tightly configured desktop systems to spacious tower PCs. One system that missed the deadline was the Compaq Deskpro/XL—a member of the XL line, which replaces the M line. Unfortunately, two vendors—Digital Equipment Corp. and Tangent Computer—could not supply CD-ROM drives.

Several systems stand out from the crowd in terms of either their mix of features, level of performance, or price:

- The Zeos Pantera-66 combines a 66-MHz Pentium CPU with excellent performance in a tower case for less than \$4,000.
- With its Matrox MGA-II video adapter, the Tri-Star P5 PCI-Station now sets the standard for Windows graphics.
- While still blazingly fast on Windows applications, the ALR Evolution V/66—a previous Editors' Choice winner—lagged under DOS.
- The Micron P60PCI Powerstation came with an astounding 16MB of disk cache, which allowed it to capture first place on our DOS disk tests and third place on our disk tests under Windows.

But buyer beware: All Pentium systems are not created equal, and you get what you pay for. At the high end is one of our Editors' Choices, the Dell OmniPlex 566. While it costs more than \$7,000, this unit offered nothing short of stellar performance across the board. The other Editors' Choice—the Zeos Pantera-66—

- **Dell OmniPlex 566**
- **Zeos Pantera-66**

Overall system performance is more complicated than wiring a hot processor to a fast hard disk and high-output Windows video accelerator. The whole is equal to more than the sum of its parts; how each part fits into an integrated whole, and important features—such as

flash-memory BIOS and a vendor's system-support history—count for a lot. In this roundup of the 31 fastest PCs on the market, several systems were able to excel in one category or more, but only two achieved premier status by putting

it all together: the Dell OmniPlex 566 and the Zeos Pantera-66.

The OmniPlex, far and away the best performing PC we've ever seen, fulfills the performance promise of Pentium. This system produced the top score on

presents a more mainstream mix of price and performance.

386...486...PENTIUM

Making the jump from the fastest 386 or from a midlevel 486 PC to a Pentium PC can be an enlightening experience. A quick game of Windows Solitaire ably shows the advantages of combining a Pentium CPU with a local-bus video subsystem. On a 386- or 486-based PC, the cards float smoothly and slowly to the bottom of the screen at the end of a game. On a Pentium PC, the cards blast off the deck with such ferocity that you'd think some-

one has thrown the deck at you in anger.

But not all of the speed you gain by trading up to a Pentium PC is due to the CPU. Today's Pentium PCs, unlike the early efforts of last year, aren't just 486 machines with new CPUs. VL-Bus, PCI, or some proprietary form of local-bus graphics offers a huge video-performance improvement over that offered by ISA or EISA-based video cards. And all are true 64-bit systems that don't suffer from the data roadblocks to which earlier systems were prone.

Unfortunately, a more powerful CPU doesn't always mean a better-performing PC. A well-optimized 486 system can sometimes give a poorly performing Pentium PC a run for its money. This was borne out in our Winstone 94, Version 1.0, benchmark test, which consists of a series of tasks performed with 12 popular Windows applications. The highest Winstone score for a 486 system we've tested is 73.8—logged by the 486DX2/66-based PCG Turbo Burst entry (December 7, 1993) from Personal Computer Graphics Corp. (The average Winstone score for 486DX2/66 systems is a more realistic 40.)

PCG's Winstone high is still better than the score of 15 of the 31 Pentium PCs in this roundup, and just slightly below the average of 76 for this group. The Dell OmniPlex posted an 88.1 on our Winstone test, barely edging out the ALR Evolution V/66, which came in at 88.0. Both machines are more than twice as powerful as the average 486DX2/66 desktop system.

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the Winstone and processor tests—the two most important—and attained the highest DOSmark score as well. On the other tests, it never strayed below average. The only thing that gives us pause in recommending the OmniPlex is its \$7,227 price, which should come down from the stratosphere sometime soon.

Priced at a more reasonable \$3,895, and just a half step down on the performance ladder is the Zeos Pantera-66. A consistently above-average performer on all our benchmark tests, the Pantera-66 should be more than powerful enough for most. The Pantera-66 goes beyond being merely a good piece of hardware. Its use of Windows for Workgroups pushes disk access into new

territory, and this is a direction that others are likely to be heading in as well.

As an added bonus, both Dell and Zeos placed in the highest category on our semiannual survey of service and reliability, (January 11, 1994) making them vendors of merit in today's turbulent market.

In addition, the \$4,799 Blue Max Monolith Business Partner P5, from International Instrumentation, came so close to the zenith in terms of features and performance that it is worthy of an Honorable Mention. Though the 60-MHz Blue Max BP P5 stumbled on our processor tests, it more than made up ground on all the other performance tests.

WHO NEEDS THIS POWER?

As you might expect, just about everything is faster on a Pentium PC. The time you used to spend getting a cup of coffee while your spreadsheet recalculated can now be spent back at your desk—wishing you had a free moment to grab a cup of coffee.

When compared with a 486DX2/66 CPU, the Pentium comes through in terms of performance. While a Pentium CPU won't enable you to type faster, it will speed up integer operations such as text reformatting, screen redrawing, and spell checking by about 80 percent. The Pentium chip performs on the order of five to six times as fast as 486DX2/66s on floating-point tasks, such as the complex mathematical modeling that is common on CAD and financial-simulation programs. While the Pentium's floating-point potential is not at the level of a RISC workstation's, the improvement over 486DX2/66 performance is impressive. Few general business applications, however, rely heavily on floating-point operations—though this is expected to change as the Pentium becomes more widely used on the desktop.

By early summer, we'll surely see faster, more capable Pentium CPUs as well, start-

ing with 75- and 90-MHz processors that will perform up to 50 percent faster than the 66-MHz Pentium. Beyond that, several next-generation CPU projects at Intel look toward expanding PC performance.

PCI TAKES THE LEAD

The last time we looked at Pentium machines (January 25, 1994), the new PCI 2.0 (Peripheral Component Interconnect) standard had barely made it off the drawing board; but the VESA-supported VL-Bus standard had already been embraced by many major PC vendors. As a result, only 3 of the 11 systems in that roundup used PCI slots while six used VL-Bus slots.

This roundup marks a watershed in the

evolution of Pentium PCs, as we see the PCI standard take the lead. Of the 31 machines in this roundup, 19 offered PCI slots and 11 used the VL-Bus standard. Compaq's Deskpro XE 560 Model 525/W rounded out the lineup with its EISA bus and QVision local-bus video system.

This breakdown is not surprising, since PCI has had the full backing of Intel, was developed specifically for the Pentium chip, and has the potential for higher throughput than ISA, EISA, or the current VL-Bus standard. Our benchmark test results for this group of machines, however, revealed that PCI setups, for now, offer only a minor performance advantage over similarly configured VL-Bus setups.

The lack of a major throughput advantage of PCI over VL-Bus may be explained by problems found in early versions of Intel's Mercury PCI-support chip sets. This chip set's biggest shortcoming is that it doesn't support write-back external cache unless expensive synchronous SRAM is

used. Of the 19 PCI systems in this lineup, 9 supported write-back external cache. The next Intel chip set, which has the code name Saturn, will support write-back external cache without the need for synchronous SRAM.

The PCI growing pains we've seen can also be laid at the doorstep of vendors that failed to effectively implement all of the features of the PCI chip set in their motherboard designs. The closeness in performance be-

tween the PCI and VL-Bus technologies indicates that the Pentium/PCI combination has yet to reach maturity.

The VL-Bus standard, which was designed specifically for 486 motherboards and has a much larger market presence than PCI, is about to get a shot in the arm. By the time you read this, VL-Bus 2.0, a revision that supports a 64-bit data path, burst mode, and 50-MHz bus

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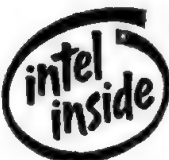


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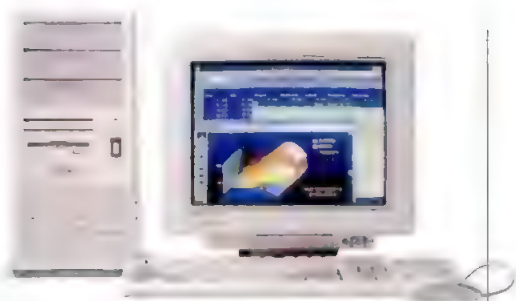
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speeds, will have been announced. VL-Bus 2.0 will present an interesting challenge to PCI 2.0, since a 64-bit version of PCI has yet to hit the market. But whether your PC has PCI, VL-Bus, or a proprietary local-bus design, the result will be the same: faster graphics and disk access than you've ever seen before.

SET-UP PROBLEMS

While PC-makers have proven that they can bring Pentium PCs to market at reasonable prices, not all of them have gotten the knack of sending their customers

office PC users since IRQ 7 may be needed for a network card.

While the conflict was easy to correct via configuration software, less sophisticated users might assume that the audio system is faulty. The advent of true plug-and-play peripherals later this year should obviate this type of problem. Similar oversights were made on other machines in this review: A CPU was loose on the Zeos Pantera-66, and a turbo switch was not activated on the Duracom DeskSaver Pentium-PCI. But the majority of problems concerned the need to update drivers.

HIGHLIGHTS

Pentium PCs

PENTIUM AND LOCAL BUS speed the operation of individual components—and also increase the perceived speed of using applications. The average Pentium system processes information about twice as fast as a 486DX2/66 PC.

PRICE USED TO SEPARATE Pentium owners from power wanna-bes. Today, with fully configured Pentium PCs costing less than \$3,000, Intel's most powerful desktop processor is within reach of most everybody.

LOCAL-BUS COMPETITION has been intense, but it appears that PCI has taken a slight lead over VESA, although little separates them in terms of performance.

TWO STOOD OUT from these 31 state-of-the-art PCs. Though expensive, the Dell OmniPlex 566 is nothing short of the fastest, most capable desktop PC today. The Zeos Pantera-66, while

more of a middle-of-the-road machine, is a better value.

EXPECT FURTHER SKIRMISHES with the impending arrival of 100-MHz 486-class processors and faster Pentium chips.

DOING A DOUBLE-SPEED CD-ROM one better, the NEC MultiSpin 3Xi drive was included with three systems—the Axik Ace Cache 586DX-66/CD, Comp & Soft C58660C512-VLB, and NEC Image P60. With data throughput of 450 kilobytes per second, this drive is 50 percent faster than the more common double-speed drive, but it is quite expensive by comparison.

IF "PENTIUM NOTEBOOK" sounds like an overheated oxymoron, never mind. A beta unit we examined from Twinhead will introduce the potential for power on the road.

We were surprised that the triple-speed NEC 3Xi MultiSpin CD-ROM drive turned up on three of the machines in this roundup—the NEC Image P60, Comp & Soft CS58660C512VLB, and Axik Ace Cache 586DX-66/CD. A triple-speed CD-ROM, which offers data throughput of 450MB per second, is 50 percent faster than a standard double-speed drive. That level of improved performance, however, is not borne out in all tasks, according to our recent review of CD-ROM drives

(February 24, 1993). In fact, some of the better double-speed drives were able to keep up with NEC's triple-speed drive in tests involving text searches and multimedia playback. The moral here is that while a NEC triple-speed drive is a good device to have on your Pentium PC, it may not be worth a large dollar premium over one of the better double-speed drives.

In addition, recent CD-ROM Editors' Choice winners showed up on several systems. The Plextor DX-3028 was used on the Duracom Desksaver, and the Sony CDU-33A was on the Austin Premier P5-60 Desktop and Unitek P60LB. The Toshiba 3401B, which showed up on 11 systems, was the most popular drive.

COOL RUNNING

When you put a Pentium chip into a PC, heat is obviously a key concern. With prices for the chip itself hovering around \$800, you certainly don't want to toast one by accident. All of the vendors in this roundup used some combination of chip-mounted fans, elaborate heat-sink assemblies, and extra case fans to supplement the ventilation fans built into standard power supplies.

Digital Equipment Corp. went to great pains to optimize the airflow patterns inside its PC to keep the CPU cool. After all, the DECpc XL line of systems will eventually accept a processor card with an Alpha CPU that consumes about twice as much power as a Pentium and, as a result, gives off even more heat.

Aavid Engineering, of Laconia, New Hampshire (603-528-3400), has an alternative to large heat sinks and fans. The company has an interesting fluid-based chip-cooling process, which requires no power and uses the same concept as do car radiators. Before you cringe at the notion of pumping water over your expensive Pentium chip, keep in mind that Aavid's process uses an inert, dielectric liquid that evaporates quickly and doesn't affect electronic components.

In one of Aavid's designs, a heat sink built into a sealed plastic package filled with fluid is mounted on top of the Pentium chip. The fluid bag itself can be mounted on an expansion card or even outside the PC. As the CPU heats, the fluid boils and rises as vapor into the empty, upper section of the sealed pouch, carrying heat away from the chip. As the vapor

machines that work correctly the first time they are powered up. For instance, even Compaq—one of the more reliable vendors—fell victim to a simple configuration mistake. On its Deskpro XE, Compaq's Business Audio system is built into the motherboard. Unfortunately, the audio system came configured to use IRQ 7, the same setting normally used by a PC's second parallel port. This may not be a problem for home users, who rarely use this port, but it may get in the way of

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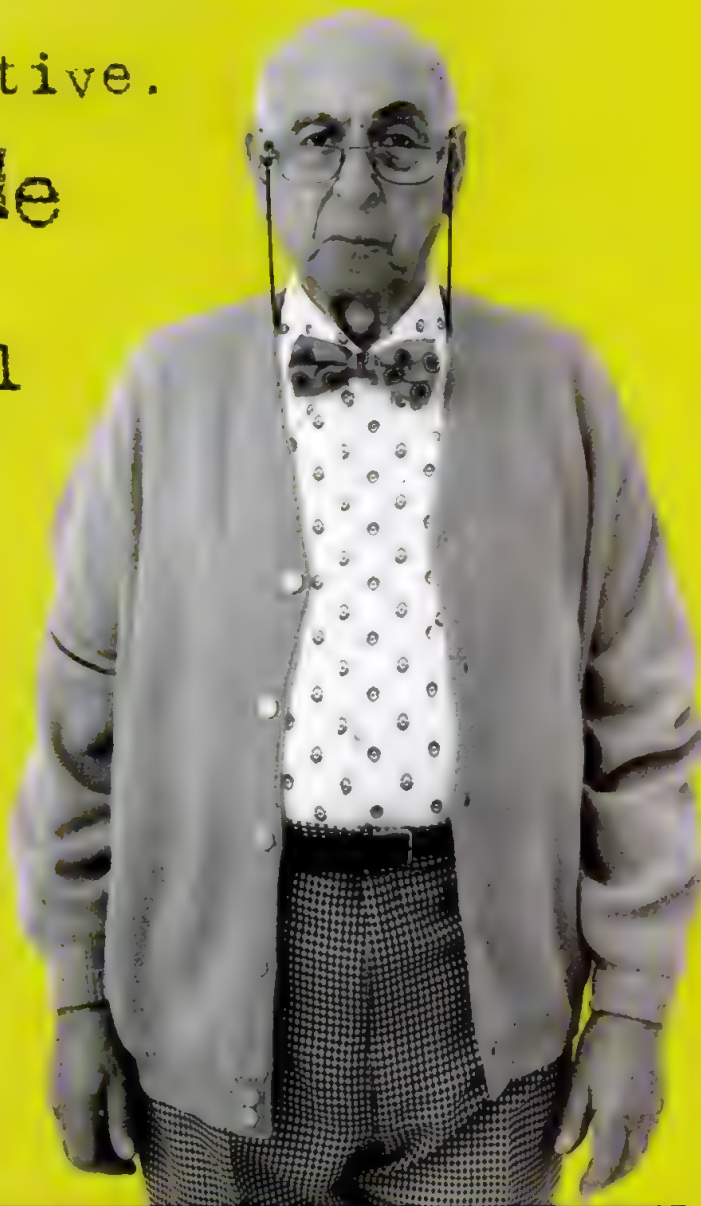
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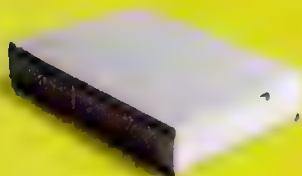
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Suitability to Task: Pentium PCs

These 31 Pentium PCs posted average ratings of good or excellent in all three Suitability to Task categories.

The **DOS applications** score reflects a system's ability to run DOS software quickly and efficiently. Excellent systems are those that earned top DOSmark scores on our benchmark tests.

Windows applications is a more demanding category; the rating indicates how well a system will operate Windows software. This score takes into account system hardware and benchmark test results, including Graphics WinMark and Disk WinMark benchmark test scores and the score each system earned on our new test, Winstone 94, Version 1.0.

We also give weight to the hardware factors germane to a system's design. For instance, the maximum RAM a system allows (either on the motherboard or through a proprietary add-in card) is especially important not only for current Windows use but down the line as well—particularly if Windows NT is in your business's long-term productivity picture. Finally, we take into account a system's hard disk options and the diagonal size of its monitor; with Windows, the bigger the better.

Those systems with excellent ratings in this category posted stellar processor scores on our benchmark tests and contained top-flight video controllers and fast hard disks, as evidenced by their excellent Graphics WinMark and Disk WinMark scores. Fewer systems garnered excel-

lent ratings in this category than in our DOS applications category.

Expandability refers to a system's potential for growth. Considerations include ease of processor and external cache upgrades, system BIOS, hard disk options, maximum RAM installable on the motherboard and via expansion cards, available drive bays and bus slots, the presence of a flash-upgradable BIOS system, and the presence of a 16550 UART high-speed serial-port chip. The best systems have drive bays and slots to spare and easily upgradable processor/cache subsystems.

With so many factors involved, it is not at all surprising that those systems with excellent ratings in this category are not just towering cases but robust models designed with multiple users in mind.

SERVICE AND RELIABILITY

In our 1994 Service and Reliability Survey, we sent questionnaires to 17,000 subscribers; about half replied.

Vendors for whom we received at least 50 responses are rated above average, average, or below average in three areas:

Reliability scores indicate to what degree PC owners felt their systems met their overall expectations for consistent operation.

Repair service scores are culled from users who contacted the vendors to have their PCs repaired.

Technical support scores measure how well vendors' telephone support met respondents' expectations.

which allows engineers to create transistors about 25 percent smaller than those used in the present 0.8-micron process. This will not only make producing Pentium chips more profitable but will also allow the processor to run at a cooler and more energy-efficient 3.3 volts.

Just when you think you have enough computing power to last you into the foreseeable future, the future shows up. It may not be long before even the Pentium chip drops out of PCs and into toaster ovens and automobile-ignition systems. At the same time, there's no doubt that operating systems and applications will become more complex. Tomorrow's PCs will require a good deal of CPU power, and the gap

between 486 chips and Pentium chips will increase; so getting a Pentium PC today puts you one step ahead in the PC power game.

Advanced Logic Research Inc.

ALR Evolution V/66

There were several systems in this roundup with better DOS performance than that of the ALR Evolution V/66. But although this unit's \$5,388 price is a little high, there were few systems that performed better under Windows.

The desktop unit came configured with 16MB of RAM—expandable to 128MB—and a standard 256K cache. The internal design of the system was relatively crowded. Although this system, which won an Editors' Choice award in our last look at Pentium PCs, still uses ALR's proprietary Evolution V motherboard, the 60-MHz Pentium has been replaced by a 66-MHz Pentium. ALR has also upgrad-



FACT FILE

ALR Evolution V/66

List price (tested configuration): \$5,388.

Processor/Memory: Pentium/66, 16MB RAM, 256K external cache. **Data storage:** Conner CP30544 527MB IDE hard disk with 64K cache, Data Technology Corp. DTC-2277VI VL-Bus-card disk controller with 1MB cache, Texel DM-3028 CD-ROM drive. **Display:** Matrox MGA-II VL-Bus-card video controller with 2MB VRAM, ALR ClearView 15 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1. **In short:** This unit lags under DOS but is speedy under Windows.

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SUITABILITY TO TASK

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Windows applications **EXCELLENT**

Expandability **FAIR**

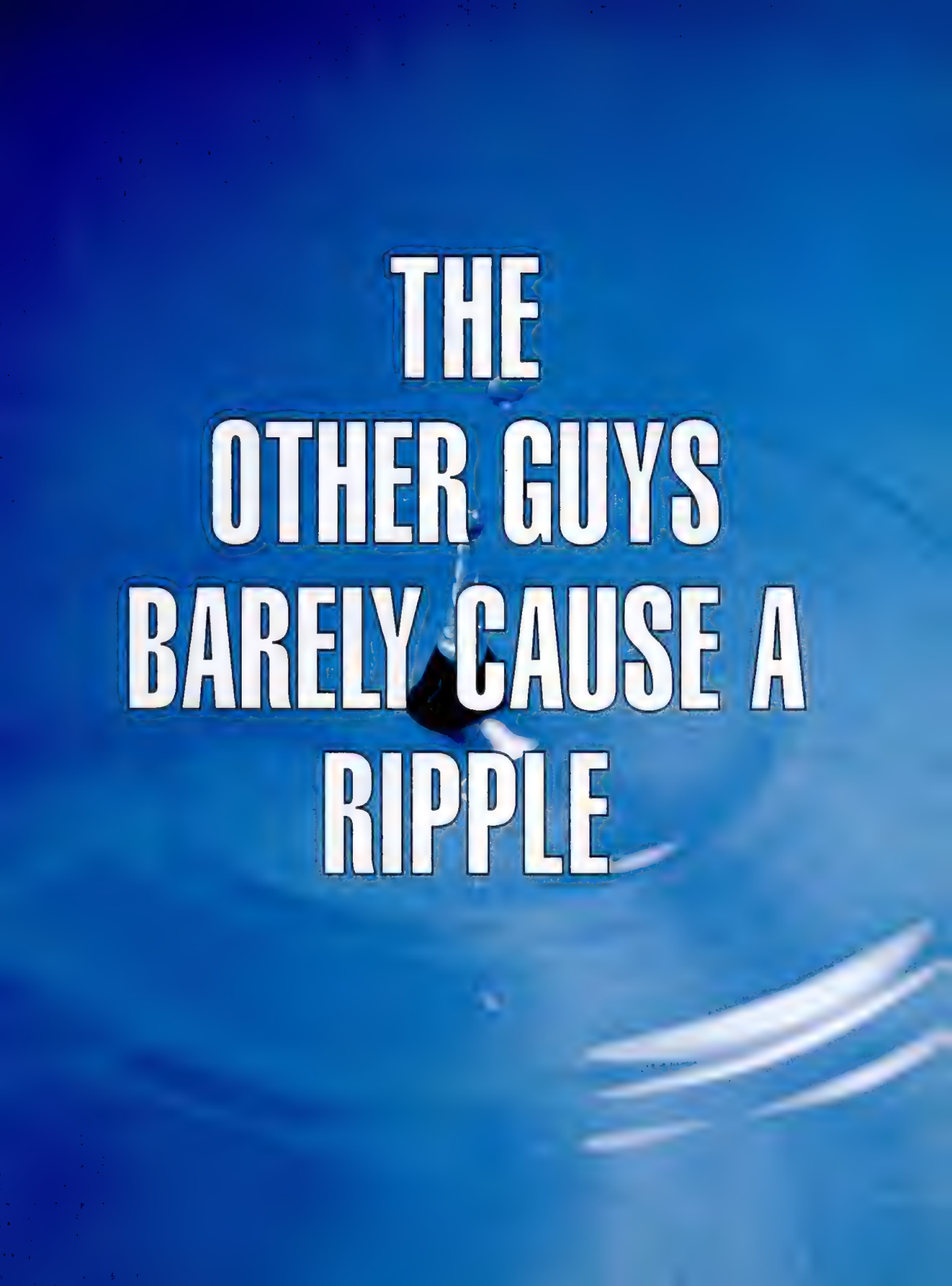
VENDOR SERVICE & RELIABILITY

Reliability **BELOW AVERAGE**
Repair service **BELOW AVERAGE**
Technical support **BELOW AVERAGE**

cools, it condenses back into a fluid and flows back to the heat sink, where the process is repeated. Aavid's technique may be most useful in the ultimate power traveler's tool: the Pentium notebook. Aavid has demonstrated how its fluid pack could be built into a notebook display.

A first look at a Twinhead Slimnote prototype shows that a fan on a notebook is not the most efficient solution to the heat problem. The Slimnote did, however, last more than an hour on a single battery charge, and it offered top-flight performance.

The need for such elaborate cooling setups should decrease sharply as Intel develops a new version of the Pentium chip based on its new 0.6-micron process,



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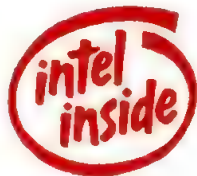
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Our expert technical support staff will provide free telephone assistance for as long as you own your system.

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During the first year, if you have a problem with your desktop system that our technicians can't solve on the phone, we'll ship replacement parts and dispatch an onsite technician. Free!

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CIRCLE 126 ON READER SERVICE CARD

DX4: Price and Performance

If the Pentium CPU seems like too much power at too high a price, and if a 486DX2/66 isn't quite powerful enough, there is a middle-ground chip. Fitting nicely between Pentiums and chips in the existing 486 family, the IntelDX4 presents an alternative for those who must temper performance with value.

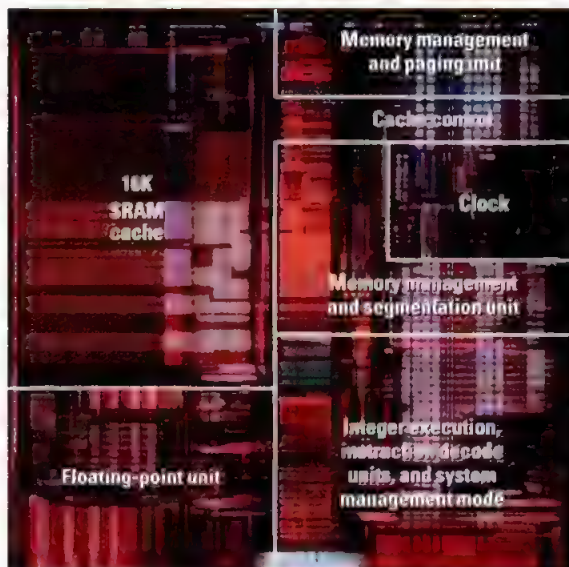
First, the DX4—due out last winter—is slightly late. Further, its name is likely to confuse potential customers: DX2 chips take their moniker from their clock-doubling technology; but while the DX4 name would imply clock-speed quadrupling, this is actually a clock-tripled chip. The DX4's name is based on the "4" in "486," and Intel hopes the DX4 name can be legally protected.

The DX4 will be available in 75-MHz and 100-MHz versions at first. The 75-MHz DX4 will complete three CPU cycles for every one of the motherboard's 25-MHz bus cycles. By comparison, the processing core of the 486DX2/66 runs at 66 MHz while the motherboard runs at 33 MHz. The 100-MHz CPU is a little trickier. It can run with motherboards that operate at

either 50 MHz—in clock-doubled mode—or 33 MHz—in clock-tripled mode.

An 83-MHz DX4 chip should be available by the time you read this, and it will run at a clock multiplier of 2.5 on a 33-MHz motherboard. Prices for the second-quarter of 1994 are expected to be \$475 and \$580 for the 75- and 100-MHz chips, respectively. While the 75-MHz chip is expected to be a popular one for power notebooks, the 83- and 100-MHz chips are more likely to end up on desktop systems. In fact, by this summer, expect fully configured 100-MHz desktop PCs costing about \$2,000 and 75-MHz notebooks costing about \$3,000; by then, desktop Pentium systems will likely cost about \$2,500. However, we expect to see 100-MHz DX4 notebooks and several low-priced 75-MHz desktop PCs.

Intel's 100-MHz DX4 Processor



With 16K of internal (L1) unified cache that supports write-through operation, DX4 CPUs have twice the on-board cache of other 486s and an amount equal to that found on Pentiums. The Pentium goes a step further, however, because its 16K internal cache is divided into data and instruction parts and is based on the more efficient write-back operation.

This doubling of internal cache raises what computer designers call the *hit rate*—that portion of data or program code found in the cache—by 2 or 3 percent to nearly 95 percent, when compared to that of 486 CPUs. While this may seem like a small increase, it significantly reduces the number of lengthy trips off the CPU to get data from the system memory or, worse, the

CPU type	Clock speeds (MHz)	Data path	Internal cache	Power use*	Voltage*	SPECint87	SPECfp87	Estimated price (second quarter of 1994)*
486SX	25, 33	32-bit	8K	3 watts	5 volts	21	N/A	\$115
486DX	25, 33, 50	32-bit	8K	8 watts	5 volts	28	13	\$280
486DX2	40, 50, 66	32-bit	8K	8 watts	5 volts	36	16	\$300
DX4	75, 83, 100	32-bit	16K	4 watts	3.3 volts	51	25	\$580
Pentium	60, 66	64-bit	16K	16 watts	5 volts	67	65	\$750

* Based on the highest clock-speed version

N/A—Not applicable. This type of chip does not contain a floating-point coprocessor

ed its video subsystem with the Matrox Graphics Accelerator (MGA) card and has added a CD-ROM drive. Although the ALR motherboard supports a 64-bit data path to the cache and memory, the motherboard is not expandable beyond the installed 256K cache.

The Evolution V/66 posted outstanding Windows scores but faltered under DOS. The system's 527MB Conner hard

disk with a VL-Bus controller achieved average scores on the DOS disk and Disk WinMark tests; Only two systems—both of which used the Matrox MGA card—had lower DOS video and DOSmark scores. The fact that these systems were also the only ones in this roundup with better Graphics WinMark scores than the Evolution V/66 says a lot about the Matrox card's Windows operations. On

the processor and Winstone tests, the Evolution V/66 finished a very close second to the Dell OmniPlex 566.—*Bill Flanagan*

Ambra Computer Corp.

Ambra DP60PCI

At a price of \$3,697, the Ambra DP60PCI from Ambra Computer Corp. is a well-

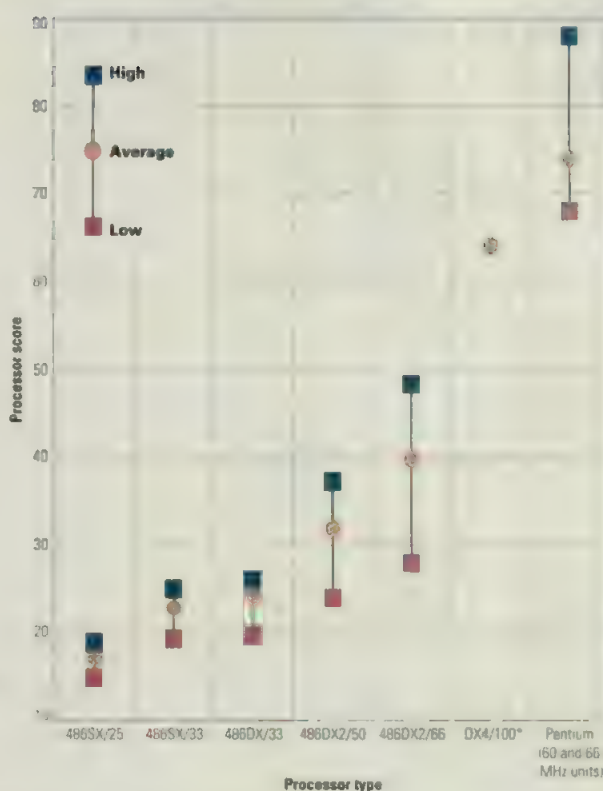
hard disk. Cache is key, and Intel recommends an additional 128K of external (L2) cache for DX4 PCs.

Pushing the clock past the current speed limit of 66 MHz and increasing the internal cache can result in a performance boost of around 50 percent. But these chips still fall short of a Pentium. The 100-MHz processor is tested at 51 integer SPECmarks and 25 floating-point SPECmarks (see the table). When compared with a 66-MHz Pentium, the DX4/100 is only slightly outperformed on integer operations, which are the mainstay of general business applications. But in terms of floating-point ability—which is used primarily for graphical and scientific programs—the DX4/100 lags markedly.

The DX4, the first chip built with Intel's new 0.6-micron semiconductor process, also has power-conservation features from the 486 SL. In addition to 3.3-volt operation, DX4 CPUs have a system management mode to stop the CPU and major components when the system is not in use; power consumption in sleep mode is less than 75 milliamperes. As a result, most DX4 PCs can easily meet Energy Star power-conservation requirements.

Two major changes are needed to designed Pentium system that went beyond middle-of-the-road performance on all our benchmark tests.

This 60-MHz Pentium PC uses quality components and came with 16MB of system memory, which can be expanded to a maximum of 128MB; its external processor cache, however, is limited to the 256K installed in the test system. Taking advantage of future technology won't be a prob-



* We tested only one system based on this processor

render 486 motherboards compatible with the DX4 chip. First, the motherboard will need a voltage regulator, which is capable of sending either 3.3 or 5 volts to the processor. Second, the system's BIOS would need to take account of clock tripling and the larger cache.

With a processor benchmark test score of 64, the DX4/100 fits neatly between the Pentium (with a score of 74) and the DX2/66 (with a score of 40); scores and averages are taken from tests conducted since our issue of December 7, 1993. The result is a smooth progression in price and performance from the 486SX through to the Pentium.—BN

lem with this system. A Diamond Viper PCI video card with 2MB of VRAM and an IDE disk controller filled two of the system's three PCI expansion slots, and Ambra has integrated a ZIF socket on the motherboard. This desktop system also provides four accessible and two internal drive bays—only two of which were occupied in our test unit—leaving plenty of room for future expansion.



FACT FILE

Ambra DP60PCI

List price (tested configuration): \$3,697

Processor/Memory: Pentium/60, 16MB RAM, 256K external cache **Data storage:** Western Digital Caviar 2540 528MB IDE hard disk with 128K cache, Intel PCI/IDE PCI local-bus-card disk controller, Philips 206 CD-ROM drive **Display:** Diamond Viper PCI local-bus-card video controller with 2MB of VRAM, Acer 7056L 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1

In short: While this unit won't break records, its excellent design manifests itself in solid benchmark test scores.

SUITABILITY TO TASK

DOS applications **GOOD**

Ambra Computer Corp.; 800-252-6272, 919-713-1550.

Windows applications **GOOD**

Expandability **GOOD**

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Average performance on all our benchmark tests proved the Ambra DP60PCI to be a well-balanced system with no shortcomings. The Ambra's processor and DOSmark scores placed it smack in the middle of the Pentium/60 subgroup. Using a Western Digital Caviar 2540 hard disk, the system turned in its most noteworthy score on the DOS disk tests, where it placed in the top ten. And contrary to what we expected, the Ambra achieved above-average Graphics WinMark and DOS video scores using the Diamond Viper PCI board with the Weitek Power 9000 chip set.

The Ambra DP60PCI is a surprising system—not so much because of the impressive performance of any one of its components but because of the way they all work together.—BF

American Multisystems

AMS InfoGold Pentium PCI

A \$3,399 price and lots of room for expansion make the AMS InfoGold Pentium PCI from American Multisystems a great system for those budget-minded users on

What the Numbers Mean

Although the top six performers on our processor tests use 66-MHz Pentium CPUs, there was little difference in overall system performance between 60-MHz and 66-MHz Pentium PCs.

WINSTONE 94

Our Winstone test, which uses 12 real-world Windows applications, stresses these systems beyond the demands of the average user and shows how well the systems are optimized. It's not just which system has the hottest graphics card or how fast the hard disk spins. For the best results, balance is key.

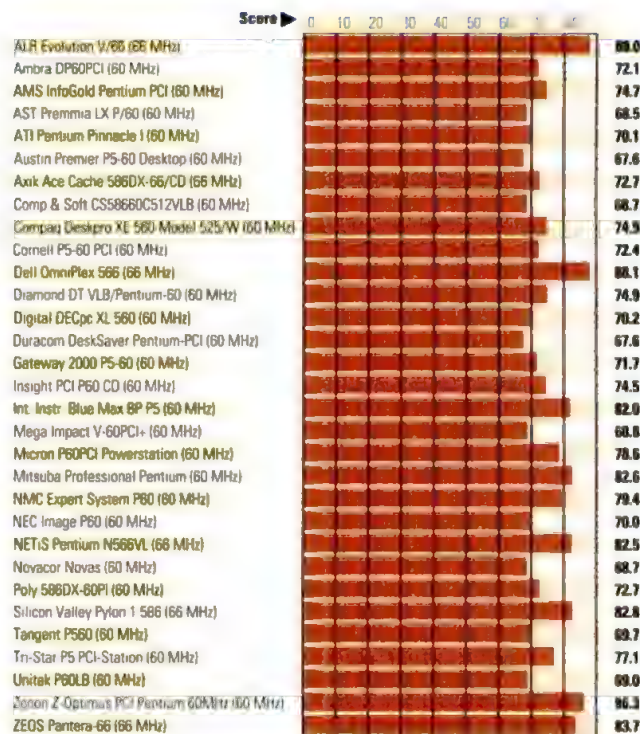
In this roundup of 31 Pentium systems, those with the highest processor, Graphics WinMark, and Disk WinMark scores generally achieved the best Winstone scores. Specifically, eight of the ten top performers on our processor tests were also top-ten Winstone performers. Likewise, eight of the top ten systems on our Disk WinMark tests ranked in the Winstone top ten, as did six of the systems with the top Graphics WinMark scores. A few turned up on several of those lists, including the Dell OmniPlex 566 and the ALR Evolution V/66. They placed first and second, respectively, on our Winstone and processor tests; their respective Winstone scores of 88.1 and 88.0 were virtually a tie. But neither system produced a Graphics WinMark or Disk WinMark score comparable with its processor and Winstone scores, although the ALR Evolution V/66, equipped with a Matrox MGA card, came close with a third-place Graphics WinMark score.

A strong processor score is the most important Winstone factor, but weaker processor scores can be compensated for, as was the case for the Zenon Z-Optimus PCI Pentium 60MHz, with an eighth-place processor score but a third-place Winstone score of 86.3. This improvement was primarily due to its Matrox card, which helped it produce a second-place Graphics WinMark score of 24.3 million. Also helping the Zenon Z-Optimus was its good Disk WinMark score of 1,350, tying the Dell OmniPlex for sixth place in this category. Conversely, the Axik Ace Cache 586DX-66/CD, a 66-MHz unit, was crippled on our Winstone test; it tied with the 60-MHz Poly 586DX-60PI for sixteenth place, with a score of 72.7. The Axik Ace Cache's score was hampered by below-average Windows graphics and disk performance.

PROCESSOR

Of the 31 systems we reviewed, 6 use Intel's 66-MHz Pentium; the majority use the less expensive and more available 60-MHz chip. The six 66-MHz systems were the top six performers on our processor test. The key differentiators are motherboard design and the array of supporting chip sets needed to manage the Pentium processor properly. Within each processor clock-

WINSTONE 94

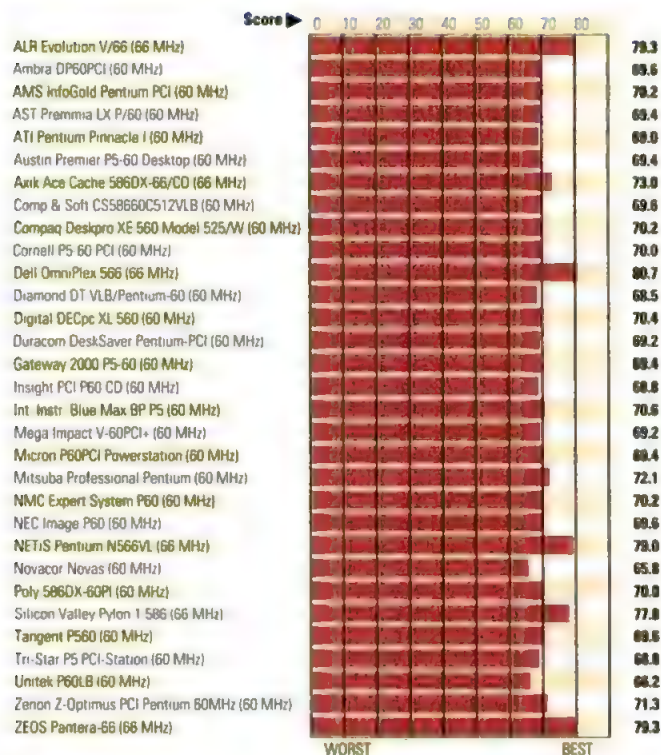


speed class, there was a 10 percent range from the slowest to the fastest systems. A performance spread is typical for same-speed processors and is caused by design variations in motherboards and chip sets. Although a 10 percent spread may seem large, it is smaller than the 30 percent range we found for 486DX2/66 PCs. The most obvious reason for this disparity is the amount of external cache.

Since Pentium systems are still fairly new, there isn't as much variation in componentry, and this is one reason why there were 20 60-MHz Pentium systems whose processor scores differed by no more than 2 points. None had an external cache smaller than 256K. And the majority of the systems are based on Intel motherboards with Mercury PCI chip sets. These are not signs of mediocrity, though. The Dell OmniPlex, the 66-MHz system with the top processor score of 80.7, also uses the Mercury chip set, on its custom-designed motherboard. The ALR Evolution V/66, which took second place with a score of 79.3, also has a custom motherboard but used an OPTi chip set.

The ZEOS Pantera-66 tied the ALR's score using the standard Intel motherboard with Intel's Mercury chip set, but it optimizes performance by halving the number of clock cycles for the read/write-cache burst transfer. Such tweaks won't necessarily change every system's performance to the same extent. The slowest of the 66-MHz systems, the Axik Ace Cache, by comparison had a threefold disadvantage in the number of cycles it took to perform read operations; its CPU score was 73.0.

PROCESSOR



GRAPHICS WINMARK

Of the 31 systems, 19 have PCI local-bus architectures, 11 use VL-Bus, and the Compaq uses the QVision local-bus architecture. Each system clearly benefited by having local-bus graphics, no matter which architecture it uses. On a percentage basis, however, those with PCI had a slight edge over VL-Bus designs in terms of their Graphics WinMark scores.

When comparable systems with 60-MHz Pentium CPUs have better Graphics WinMark scores than PCs with 66-MHz processors, other factors must be at work. The three pivotal factors are graphics memory, local-bus design, and the driver used. Of the PCI local-bus PCs with the same graphics chip, driver, and amount of video RAM, 42 percent did better than expected, based on their processor rank. The same measure applied to VL-Bus designs shows that 36 percent did better than their processor rankings.

If Windows is your mainstay, consider the performance of the Matrox MGA card. It's the new king of the Graphics WinMark tests, overthrowing the Weitek P9000. The three systems with the top Graphics WinMark scores—the Tri-Star P5 PCI-Station, Zenon Z-Optimus, and ALR Evolution V/66—all used the Matrox card. The top two systems had PCI renditions and large catapults relative to their processor-score rankings. The 60-MHz Tri-Star PCI-Station produced a Graphics WinMark score of 25.2 million; the difference in rank between this first-place score and its processor score (twenty eighth-place) was the greatest of all 31 tested systems. Its PCI Matrox card also had

GRAPHICS WINMARK



4MB of RAM; each of the other two systems held 2MB. The Zenon Z-Optimus, another 60-MHz system, produced a second-place Graphics WinMark score of 24.3 million, rising from its eighth-place processor rank. The ALR Evolution V/66, with a 66-MHz Pentium CPU and a VL-Bus version of the Matrox card, generated a third-place Graphics WinMark score of 23.7 million and actually dropped slightly from its second-place processor position. On the average, when looking at PCI or VL-Bus renditions of systems having Diamond's Viper card, which has the Weitek P9000 chip, we find similar shifts in Graphics WinMark ranks relative to processor scores. Likewise, on the average, systems with ATI 68800AX graphics chips switched Graphics WinMark ranks relative to their processor ranks, with the advantage going to PCI-equipped systems over those with the VL-Bus.

VIDEO

Weitek's P9000 chip may have lost its Windows crown to the Matrox chip, but the Matrox card didn't do very well in DOS video tasks. The three Pentium systems with Matrox cards—the ALR Evolution V/66, Tri-Star PCI-Station, and Zenon Z-Optimus, did poorly on our PC Bench video tests, with scores no higher than 576. They underperformed the systems based on the Weitek chip by more than 50 percent.

It's not easy to find a video card capable of performing well under both Windows and DOS. But ATI's new 68800AX chip set on the Dell OmniPlex did a good job of providing a

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computer systems at 486 prices? With a Gateway 2000 P5 system you can have one of the highest-performance systems in the industry at a phenomenal value. In fact, we're now offering four Pentium-based systems including a new 66MHz model, priced from \$2,495 to \$3,995.

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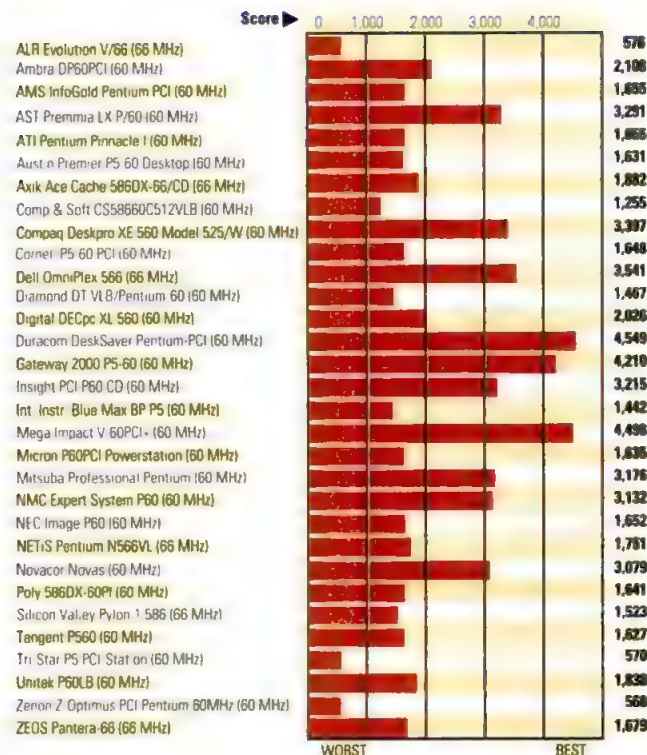
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Benchmark Tests: Pentium PCs

VIDEO



reasonable compromise. For instance, in DOS video the Dell ranked fourth, with a score of 3,541; in Windows video it scored a very respectable 19.7 million. The Gateway 2000 P5-60, with a PCI implementation of the same ATI chip, ranked third, with a DOSmark score of 4,210, but dropped to a below-average 14.4 million on the Graphics WinMark tests.

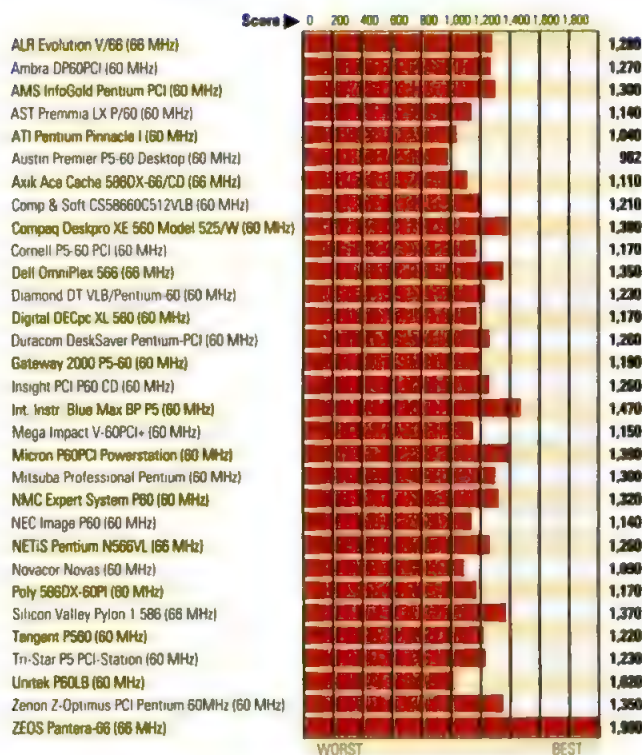
DISK AND DISK WINMARK

Systems with good processor scores naturally tend to do well on our disk tests. When a system with average processor performance rises to the top on our DOS disk and Disk WinMark tests, you know that system has either a super fast disk or an extremely efficient hardware cache controller.

The Micron P60PCI Powerstation has both: a Maxtor MXT-540A hard disk and a Tekram DC-690 PCI cache controller card outfitted with 16MB of RAM. The two components netted for the Micron Powerstation (a 60-MHz Pentium system with an average processor score) the number-one DOS disk score of 1,680. While this model of the Tekram card and its large cache obviously helped things, the Maxtor disk by itself is fast.

The same hard disk, in SCSI form and sans the large cache, was also in the second- and fourth-place DOS disk finishers—the 60-MHz AMS InfoGold Pentium PCI and Zenon Z-Optimus. National MicroComputers' NMC Expert System P60 had this Maxtor hard disk, too, but with a 4MB VLB-Bus Tekram DC-880 controller, the disk did not perform as well as it did in the other three systems.

DISK WINMARK



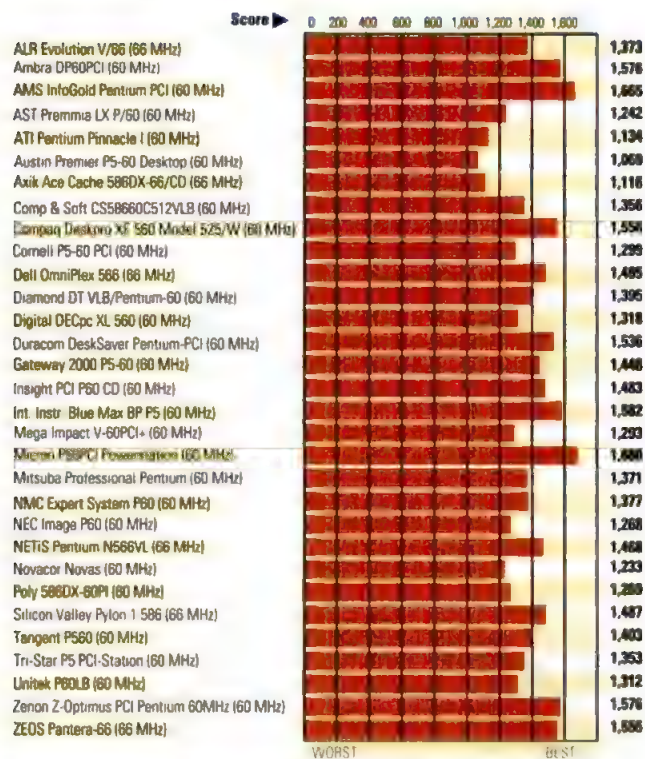
Though the Disk WinMark tests run the same routines as our DOS disk tests do, Windows itself can change a system's behavior. For instance, it is PC Labs' testing policy to turn on Windows' 32-bit disk access when a system will accept it; some systems don't support 32-bit operations because of driver conflicts, among other things. We also make sure a standard swap file is in place. Such optimizations can increase Disk WinMark performance relative to DOS disk performance. But because of its processing overhead, Windows 3.11 more often limits the net increase and can even bring performance down, relative to DOS.

The latest version of Microsoft Windows for Workgroups (WFWG) incorporates a new 32-bit file-access setting, reducing task overhead. In this roundup, only one of the systems came with WFWG preinstalled: the 66-MHz ZEOS Pantera-66, whose Disk WinMark score put it in first place; its DOS disk score put it in seventh place. The ZEOS Pantera-66 had no caching controller paired with its Western Digital Caviar 2540 hard disk, but not only did it rank first on our Disk WinMark tests, its score surpassed the next-closest competitor, International Instrumentation's Blue Max Monolith Business Partner P4, by 35 percent. The Blue Max uses a 4MB Promise caching controller with a Conner CP-30544 hard disk.

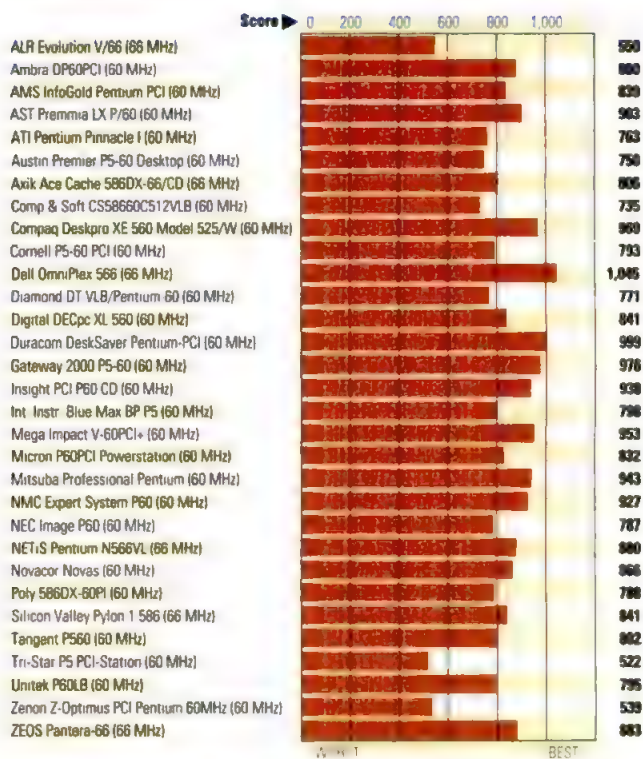
DOSMARK

Processor, DOS video, and DOS disk performance are important in determining a system's DOSmark score. Because of their subordinate video scores, all the systems with Matrox

DISK



DOSMARK



cards earned DOSmark scores of or below 550. The Weitek P9000-based systems usually fared better, often aided by their high processor and disk scores. All these systems settled in the 700 to high-800s DOSmark range. 18 of the 31 systems in this review had Diamond Viper cards using the Weitek P9000 chip.

The most impressive DOSmark scores were turned in by those systems with strong DOS video performance. Among them are systems with graphics chips from ATI, S3, and Tseng Laboratories. Because of its first-place processor score and the good DOS video performance produced by its ATI chip, the Dell OmniPlex's outstanding DOSmark score of 1,045 was first-place—and the highest DOSmark score we've seen so far.

—Analysis written by Tami D. Peterson

How We Tested

In preparing this issue, we used PC Bench 8.0 to predict processor, video subsystem, and disk performance using DOS applications. The DOSmark is a summary of those three results and estimates system performance under DOS. We also used WinBench 4.0 to obtain Graphics and Disk WinMark scores, and we used the application-based Winstone 94, Version 1.0, to determine overall system performance under Microsoft Windows 3.1.

Winstone 94, Version 1.0, measures the time a PC takes to execute a set of application scripts that exercise 12 of the most popular Microsoft Windows 3.1 applications. We normalize Winstone scores relative to a 386DX/25 Compaq Deskpro/M with 4MB of RAM, which has a Winstone score of 10. The Winstone scores let you compare overall system performance under Windows; a system with a Win-

stone score of 20, for example, performs twice as fast as one with a score of 10.

The **processor** score reflects CPU, RAM, and RAM cache performance. It is based on a large instruction mix and either the floating-point coprocessor test or the floating-point emulation test, depending on whether the PC has a coprocessor—which could be either integrated with the main processor or located on a separate chip.

The **Graphics WinMark** score is a measure of PC graphics performance under Microsoft Windows 3.1. We run 66 different tests—divided into seven graphics test mixes—to evaluate each system's handling of the Windows GDI (Graphics Device Interface). These tests are based on extensive application profiling.

The DOS-based **video** score is a weighted harmonic mean of tests that measure 8- and 16-bit VGA write operations involving both text and graphics.

The **Disk WinMark** score reflects disk subsystem performance under Microsoft Windows. The tests use different files and file operations in a blend based on extensive profiling of applications' disk usage.

The DOS-based **disk** score gauges the performance of a PC's disk subsystem, which includes the hard disk, disk controller, and any hardware or software disk caches. Our tests use more than 100 files in six directories totaling over 30MB. The operations performed include file reads, file writes, file creation, and file deletion.

The **DOSmark** score is a composite rating derived from the processor, video, and disk scores. It indicates a PC's ability to run DOS applications quickly and efficiently.



► FACT FILE

AMS InfoGold Pentium PCI

List price (tested configuration): \$3,399
Processor/Memory: Pentium/60, 16MB RAM, 256K external cache **Data storage:** Maxtor MXT-540S 546MB Fast SCSI-2 hard disk with 256K cache, NCR PCI Fast SCSI-2 PCI local-bus-card disk controller, Sony CDU-561 CD-ROM drive **Display:** Diamond Viper PCI local-bus-card video controller with 2MB of VRAM, InfoGold 5000 17-inch monitor with a 72-Hz refresh rate at 1,280-by-1,024
Software: DOS 6.2, Windows 3.11 **In short:** Price and expansion room make the reasonably performing AMS InfoGold Pentium PCI an ideal system for budget-conscious buyers.

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SUITABILITY TO TASK

DOS applications GOOD
Windows applications GOOD
Expandability GOOD

the lookout for power and expandability.

The tested system came configured with a 60-MHz Pentium CPU, 16MB of RAM, and a 256K cache. This tower system has four accessible and three internal drive bays, and eight expansion slots, three of which are PCI slots. The motherboard has six SIMM banks, which can hold a maximum of 192MB RAM. Secondary cache can be upgraded from 256K to 512K.

For the most part, the InfoGold's benchmark test scores were on a par with those of similarly configured systems but just couldn't match those of the best systems. The InfoGold is a good all-around Pentium PC. Its DOS performance was average, with processor and DOSmark scores that placed the unit in the middle of the pack. The unit's most outstanding performance was on our DOS disk tests. A PCI-based Fast SCSI-2 controller without cache combined with a Maxtor 546MB Fast SCSI-2 hard disk allowed the InfoGold to turn in a DOS disk score that was second only to the Micron P60PCI Powerstation—a unit that had a PCI-based IDE controller with 16MB of disk cache. The InfoGold's Windows perfor-

mance, however, was unremarkable; its Disk WinMark, Graphics WinMark, and Winstone scores were on par with that of the other systems in this roundup.

With the AMS InfoGold Pentium PCI, American Multisystems has shown that sometimes you get more than what you pay for. In this case, you get a better-than-average Pentium system with expansion potential at a competitive price.—BF

AST Research Inc.

AST Premmia LX P/60

Although the \$5,545 AST Premmia LX P/60 offers more room than the average slimline desktop system, this unit, with its average DOS performance and low benchmark test scores under Windows, was overshadowed by similarly priced but better performing PCs.

Surprisingly, AST Research did not use either of this system's two PCI



► FACT FILE

AST Premmia LX P/60

List price (tested configuration): \$5,545 **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache **Data storage:** Quantum LP540A 494MB IDE hard disk with 128K cache, integrated disk controller, Toshiba 3401B CD-ROM drive **Display:** Integrated local-bus-card video controller with 1MB of VRAM, AST Vision 7L 17-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024
Software: DOS 6.0, Windows 3.1 **In short:** The slimline AST Premmia LX P/60's average DOS performance doesn't make up for its bottom-of-the-barrel Windows scores.

AST Research Inc.;
800-876-4278, 714-
727-4141.

453 On reader service card

SUITABILITY TO TASK

DOS applications GOOD
Windows applications FAIR
Expandability FAIR

VENDOR SERVICE & RELIABILITY

Reliability ABOVE AVERAGE
Repair service AVERAGE
Technical support AVERAGE

expansion slots; it chose instead to go with the motherboard's integrated video and disk controllers. While this approach may lower costs, it is usually at the expense of top-flight performance. The improved performance that results from the addition of a PCI-based video card or disk controller may justify the increase in the price of the overall system.

On our benchmark tests, the Premmia's Windows performance was among the worst in the group. The unit, which uses an ATI Mach32 chip set integrated on the motherboard, turned in a poor Graphics WinMark score but, as expected, did very well on DOS-based video tests. Unfortunately, the system's Quantum 494MB hard disk posted below-average scores on both our DOS-based disk tests and Disk WinMark tests. But the Premmia's overall DOS performance was fairly good, as shown by its relatively high DOSmark score. Its Winstone score, however, was below average.

Outperformed by other units in this roundup with similar local-bus technology, the AST Premmia LX P/60 has the potential for better and more well-rounded performance in the future.—BF

ATronics International Inc.

ATI Pentium Pinnacle I

The ATI Pentium Pinnacle I from ATronics International is a tower system that, despite being outfitted with some quality components and PCI technology, failed to follow through with high-end performance in terms of DOS and Windows performance.

With a price of \$3,995, the 60-MHz Pinnacle I went beyond our standard configuration to include a sound card and a set of speakers for multimedia aficionados. With five drive bays and four expansion slots (including one PCI slot) still available in the system we tested, the Pinnacle I does not leave anything to be desired in terms of expandability. System memory can be expanded from 4MB to 192MB, and the 256K cache can be upgraded easily to 512K.

This unit scored a glowing 19.4 million pixels per second on our Graphics WinMark tests with its Diamond Viper PCI card. While not the best, this score



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was well above average, and in line with other systems using this video subsystem; the unit's low DOS-video score was on a par with such systems as well. The use of the PCI bus to control the Conner 340MB hard disk failed to improve performance on either the DOS disk or Disk WinMark tests as dramatically as it did on some of the other systems using this technique. In fact, the Pinnacle I was outperformed by some systems using less advanced controllers. The unit's processor score was below average, as was its score on our



► FACT FILE

ATI Pentium Pinnacle I

List price (tested configuration): \$3,995

Processor/Memory: Pentium/60, 16MB RAM, 256K external cache **Data storage:** Conner CFA340A 340MB IDE hard disk with 64K cache, ATronics IDE PCI local-bus-card disk controller, Toshiba 3401B CD-ROM drive

Display: Diamond Viper PCI local-bus-card video controller with 2MB of VRAM, CTX CMS-1561 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.0, Windows 3.1 **In short:** Despite high-end components, only a sound card and speakers distinguish the under-achieving ATI Pentium Pinnacle I from its competitors.

ATronics International
Inc., 800-488-7776,
510-656-8400

454 On reader service card

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

Winstone benchmark test.

With other tower systems in this roundup offering better or equal performance for a better price, the Pinnacle I will be forced to play catch-up both now and the future.—BF

Austin Computer Systems

Austin Premier P5-60 Desktop

Depending on your outlook, you could see the Austin Premier P5-60 Desktop as a glass that is either half full or half empty. At \$2,795, this is an inexpensive system



► FACT FILE

Austin Premier P5-60 Desktop

List price (tested configuration): \$2,795

Processor/Memory: Pentium/60, 16MB RAM, 256K external cache **Data storage:** Western Digital Caviar 2420 424MB IDE hard disk with 256K cache, integrated disk controller, Sony CDU-33A CD-ROM drive **Display:** Diamond Viper PCI local-bus-card video controller with 2MB VRAM, Austin MN2404 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1 **In short:** The Austin Premier P5-60 Desktop performed poorly on our tests, but it offers plenty of expansion potential for budget-conscious do-it-yourselfers.

Austin Computer
Systems, 800-752-1577,
512-339-3500

455 On reader service card

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR

with a lot of potential for upgrading and customization. On the other hand, because this system turned in performance scores that were among the worst of the group, it would be hard to recommend it—at any price—to anyone but the avid PC customizer and tweeker.

With performance that was consistent in the cellar—this unit turned in last-place scores, for example, on the DOS disk, Disk WinMark, and Winstone tests—the 60-MHz Premier doesn't measure up to the competition. A look inside the system, however, shows that the Premier uses the same motherboard as the Ambra and Tangent systems. Those systems benefited from the use of a PCI-based controller while Austin Computer Systems chose to use the motherboard-integrated controller for its Western Digital Caviar 424MB hard disk, leaving two PCI slots available. The addition of a PCI-based hard disk controller would likely boost both disk and overall system performance while pushing the price up as well.

Of all the systems using the Diamond Viper PCI card for graphics, the Premier

posted one of the lowest DOS video scores; the unit's processor score was among the lowest as well.

Basically, the Austin Premier P5-60 Desktop is an inexpensive system that performs poorly but has a lot of expansion potential.—BF

Axik Computer Inc.

Axik Ace Cache 586DX-66/CD

At \$4,598, the Axik Ace Cache 586DX-66/CD is a VL-Bus-based system that packs a lot of quality components into a large tower case but doesn't get the high-performance results from them that one might expect.

When examining the system, the first thing you might notice is the generous amount of space: Ten drive bays littered the inside of the case. Even with all this space, however, the I/O card, CD-ROM controller card, hard disk controller card, and video adapter obscure the motherboard with cables. The triple-spin NEC MultiSpin 3Xi CD-ROM drive is a nice touch of quality, but most people would



► FACT FILE

Axik Ace Cache 586DX-66/CD

List price (tested configuration): \$4,598

Processor/Memory: Pentium/66, 16MB RAM, 512K external cache **Data storage:** Maxtor 7345AT 322MB IDE hard disk with 64K cache, Promise Technologies DC-4030VL VL-Bus-card disk controller with 4MB cache, NEC MultiSpin 3Xi CD-ROM drive **Display:** Diamond Viper VLB video controller with 2MB VRAM, ADI MicroScan ADI4G 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Windows 3.1 **In short:** While the Axik Ace Cache 586DX-66/CD's performance leaves room for improvement, its expandability is virtually unrivaled.

Axik Computer Inc., 800-234-2945, 408-735-1234

456 On reader service card

SUITABILITY TO TASK

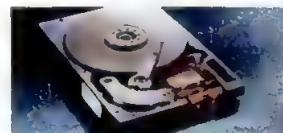
DOS applications	GOOD
Windows applications	GOOD
Expandability	EXCELLENT



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expect to see it accompanied by a sound card of equal merit.

On our benchmark tests, the Ace Cache performed on a par with similarly configured systems. But this unit, which uses a Maxtor 322MB hard disk, posted poor DOS disk and Disk WinMark scores considering that the system uses a 4MB VL-Bus caching controller. Even though the Ace Cache uses a 66-MHz chip, its processor score—while in the top ten—was more in line with that of a machine using a 60-MHz chip. As seen by the Ace Cache's Winstone score, overall Windows performance was below average, although the Diamond Viper VL-Bus card allowed the system to post scores that were on a par with similarly configured systems.

Although the Ace Cache is unrivaled in terms of expansion potential, the \$4,598 price does raise one's expectations of the unit's performance. In this roundup, you can find equal or better performance at a lower cost.—BF

Comp & Soft Experts

Comp & Soft CS58660C512VLB

As its long-winded name indicates, the Comp & Soft CS58660C512VLB is a 60-MHz Pentium with a 512K secondary cache and VL-Bus architecture. What the name doesn't tell you is that it is a well-equipped mini-tower with average performance scores and a price of \$4,999.

Seven drive bays, five 16-bit ISA slots, and three VL-Bus slots make up the innards of the system. The motherboard is expandable to 128MB, and the cache reaches its limit at the 512K that was installed. The system is relatively spacious inside, with none of the all-too-common crowding from cables and wires. Keep in mind that the unit's price does include a high-end NEC 4FGe monitor and a triple-speed CD-ROM drive—the NEC MultiSpin 3Xi—both of which are relatively expensive items.

On our benchmark tests, the unit's DOS performance was marred by a poor video score, which was reflected in the system's low DOSmark score. Out of all the systems in this roundup using the



► FACT FILE

Comp & Soft CS58660C512VLB

List price (tested configuration): \$4,999

Processor/Memory: Pentium/60, 16MB RAM, 512K external cache **Data storage:** Seagate ST3550N 456MB Fast SCSI-2 hard disk with 256K cache, BusLogic BT445S VL-Bus-card disk controller, NEC MultiSpin 3Xi CD-ROM drive **Display:** Diamond Viper VLB video controller with 2MB VRAM, NEC 4FGe 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.1, Windows 3.1, Lotus 1-2-3 **In short:** This unit features a high-end monitor, CD-ROM drive, and low-end performance.

Comp & Soft Experts:
800-327-8486, 314-298-1900

457 On reader service card

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

Diamond Viper VL-Bus card, this unit posted the worst DOS video score; the system's Graphics WinMark score, however, was on par with other systems using this video card. DOS disk and Disk WinMark scores were close to average, due in part to the BusLogic VL-Bus controller. This unit's Winstone score was one of the lowest of the group.

A long look at the Comp & Soft CS58660C512VLB shows that Comp & Soft has its priorities in order. They put more thought into selecting the unit's components than into giving the unit its name.—BF

Compaq Computer Corp.

Compaq Deskpro XE 560 Model 525/W

The \$5,128 Compaq Deskpro XE 560 Model 525/W is a well-designed machine that combines quality integrated technology with strong DOS and Windows performance and an impressive array of features.

Although this unit doesn't have as much

expansion room as some of the others, Compaq has anticipated many of the user's initial needs—such as audio and high-end video—and integrated onto the motherboard its Business Audio and enhanced QVision local-bus graphics subsystem. The Deskpro XE comes equipped with a microphone that can be used to annotate documents or to train the system to carry out simple voice-activated commands.

In addition, Compaq included a Fast SCSI-2 adapter card in one of the system's three 16-bit ISA slots. The system we tested came with 24MB of RAM (expandable to 136MB) and 256K of external processor cache. On our benchmark tests, the Deskpro XE's DOS performance was consistently high across the board.

The QVision chip set enabled the system to post an outstanding DOS-based video score, and the Quantum ProDrive hard disk pushed the unit into a top-ten



► FACT FILE

Compaq Deskpro XE 560 Model 525/W

List price (tested configuration): \$5,128 (estimated) **Processor/Memory:** Pentium/60, 24MB RAM, 256K external cache **Data storage:** Quantum ProDrive LPS 525 527MB IDE hard disk with 16K cache, integrated disk controller, Compaq CD-ROM drive **Display:** Integrated video controller with 1MB VRAM, 15-inch Compaq 1024 Color Monitor 461 with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.0, Windows 3.1, TabWorks, Microsoft Windows Sound System. **In short:** Quality components compensate for a shortage of expansion room in this solid-performing machine.

Compaq Computer Corp.; 800-345-1518, 713-378-8820.

458 On reader service card

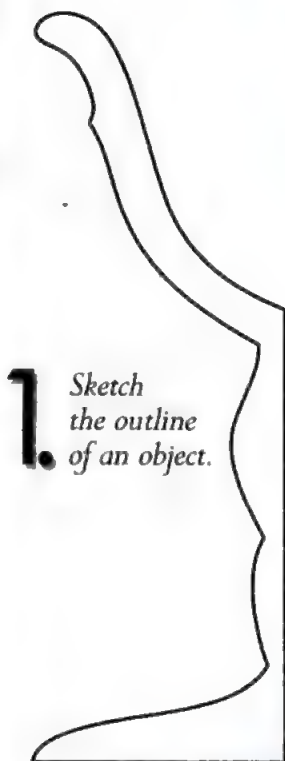
SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	POOR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

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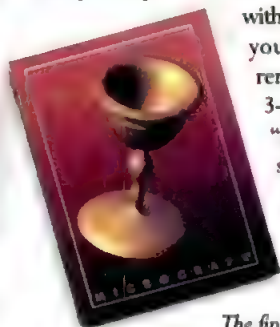
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position on our DOS disk tests. This disk subsystem also helped the Deskpro XE finish in fourth place on our Disk WinMark tests. The unit's processor score—achieved via its 60-MHz Pentium—was average, as was the unit's score on our Winstone test.—BF

Cornell Computer Systems

Cornell P5-60 PCI

The high price on some of the Pentium systems in this roundup opens the door for those PC makers who can deliver adequate performance at a lower price. Cornell Computer Systems' \$4,095 Cornell P5-60 PCI is a system that offers roughly average overall performance at a nice price.

In many ways, this system is similar to many of the other tower PCs in this roundup: Six accessible and two internal drive bays give it the storage capacity to become an effective file server if need be. The PCI slots integrated on the motherboard also mark this system as an effective workstation for the power user.



► FACT FILE

Cornell P5-60 PCI

List price: \$4,095 **Processor/Memory:**

Pentium/60, 16MB RAM, 256K external cache **Data**

Storage: Conner CP30540 545MB SCSI-2 hard disk

with 512K cache, NCR SC200P PCI local-bus-card disk

controller, Toshiba 3401B CD-ROM drive **Display:**

Diamond Viper PCI local-bus-card video controller

with 2MB VRAM, ADI MicroScan 4G 15-inch monitor

with a 60-Hz refresh rate at 1,280-by-1,024

Software: DOS 6.2, Windows for Workgroups 3.11

In short: With quality components, the Cornell P5-60 PCI turned in midrange scores.

Cornell Computer Systems; 800-886-7200, 909-594-5848

459 On reader service card

SUITABILITY TO TASK

DOS applications GOOD

Windows applications GOOD

Expandability GOOD

■ Price/Performance Index: Pentium PCs

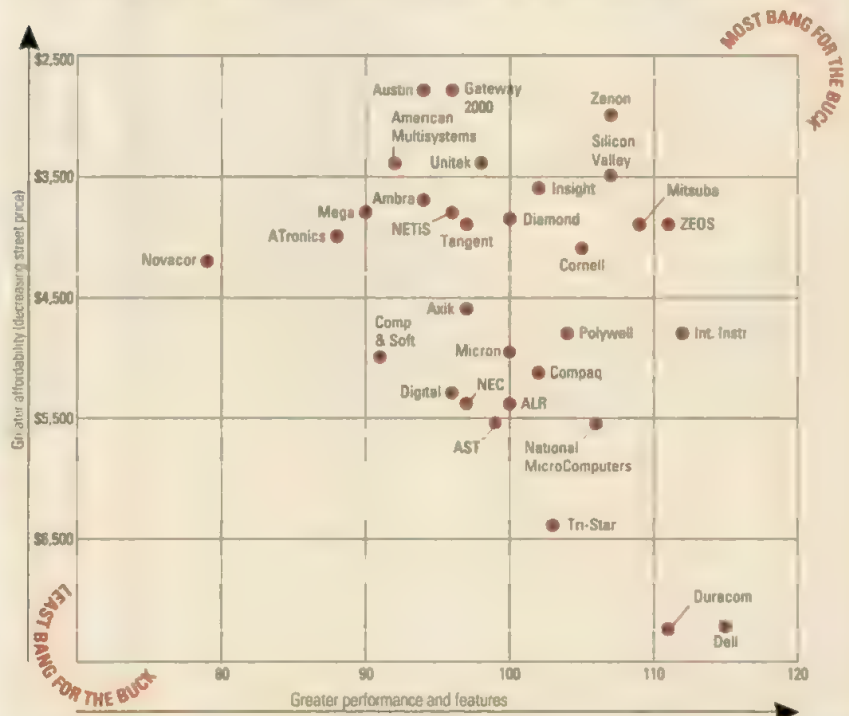
Though it has the second-highest price of this group, the \$7,227 Dell OmniPlex 566 turned in performance scores that consistently placed it in the top ten. The ZEOS Pantera-66 combines a full set of features with evenhanded performance under both DOS and Windows—a rare feat—at \$3,895. International Instrumentation's \$4,799 Blue Max Monolith Business Partner P5, though a strong candidate, missed out on top honors because of its low DOSmark score and relatively high price.

The laggard of the group—the Nov-

acor Novas—has a middle-of-the pack price of \$4,201 but had the second-to-last Graphics WinMark score.

THE DATA POINTS

In calculating performance/feature scores, we gave Winstone and DOSmark scores the most weight. We also looked at the warranty, on-site service charge, and expansion capabilities. The combined benchmark test scores account for 66 percent of each score; all else accounts for 34 percent. For more information, look in the Software Library of the Editorial Forum on PC MagNet under 07BANG.XLS.



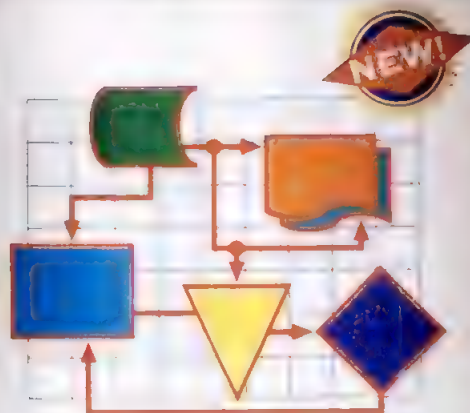
The P5-60's performance scores ranged from disappointing to midrange. The processor score was average. This system, which used a Diamond Viper PCI card, turned in DOS video and Graphics WinMark scores in line with the majority of systems using the same video card.

Although the DOS Disk and Disk Winmark scores were a little below average, the NCR PCI local-bus controller

managed to keep the unit's 545MB Conner hard disk from falling off the pace too far below that. The P5-60's Winstone score was only slightly below average; its DOSmark score was below average.

If you're looking for a system that's not too pricey when compared with many other systems in this roundup, the Cornell P5-60 PCI is one system that might catch your eye.—BF

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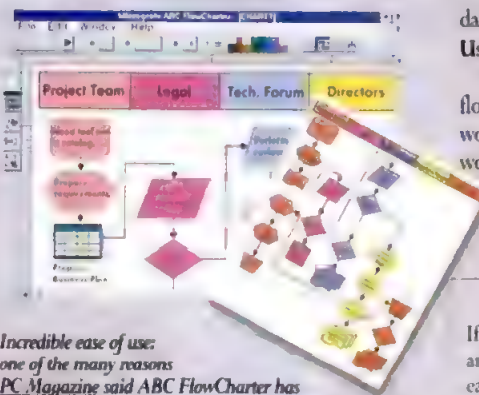
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Dell Computer Corp.

Dell OmniPlex 566

The Dell OmniPlex 566 easily has the most usable and flexible design of any system in this roundup, and it produced the highest and most consistent performance scores in both the DOS and Windows arenas. This 66-MHz Pentium system performs on all fronts the way Pentium PCs were expected to; at \$7,227 though, it is priced the way we feared these systems would be as well.

Dell has integrated state-of-the-art technology into this system, either as an expansion possibility or directly onto the motherboard. An ATI 68800 graphics accelerator is connected to the PCI local bus on the motherboard. There are seven slots on a riser off the motherboard, five of which are EISA and two of which are PCI local bus. Because of the way these

slots are arranged, the system can accommodate a maximum of only five expansion cards at once: The PCI sockets share the same slot space as two of the EISA slots, making one or the other—but not both—usable at any one time. Also integrated on this riser is a built-in SCSI adapter for further expansion.

On our benchmark tests, the OmniPlex was unmatched. All of its scores fell in the top ten; many put it in first place. The ATI 68800 chip set allowed the unit to post strong scores on both the DOS-based video and the Graphics WinMark tests. With top DOSmark, processor, and Winstone scores, the OmniPlex was a consistent performer under both DOS and Windows.

This EISA/PCI-based OmniPlex is truly an impressive machine. Though expensive, it is worth every penny.—*BF*

Diamond Technologies Inc.

DT VLB/Pentium-60

The Diamond Technologies DT VLB/Pentium-60 is a system that combines middle-of-the-road performance with a very attractive price of \$3,849.

The standard tower case, which houses a 60-MHz chip, holds nine drive bays and a 250-watt power supply. The system we tested had 16MB of RAM (can be expanded up to 128MB) and a 256K cache (can be expanded to 1MB). By including a Tekram DC-880 SCSI adapter card, Diamond Technologies also showed that its engineers were thinking in terms of expandability for high-end PC users.

Unfortunately, the VLB/Pentium-60 performed poorly under DOS on our benchmark tests—as reflected by the machine's DOSmark score, which ranked in this roundup's bottom ten. The unit garnered a low DOS video score as well, which was due in part to the system's Diamond Viper VLB video controller. Only two systems had lower processor scores.

The 344MB Maxtor hard disk with a VL-Bus controller was augmented with 4MB of cache on the controller and 64K of cache on the hard disk. On the whole, this subsystem performed well and managed decent though not outstanding results on the DOS disk and Disk WinMark tests. Graphics WinMark and Win-



FACT FILE

DT VLB/Pentium-60

List price: \$3,849 **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache **Data storage:** Maxtor 7345SR 344MB SCSI hard disk with 64K cache, VESA DC-880 VL-Bus-card disk controller with 4MB cache, Toshiba 3401B CD-ROM drive **Display:** Diamond Viper VLB video controller with 2MB VRAM, MAG InnoVision MX15H 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.0, Windows 3.1 **In short:** The DT VLB/Pentium-60 is a unit that demonstrated average performance under Windows and offers plenty of room for expansion.

Diamond Technologies Inc.; 800-989-7253, 714-533-9910.

461 On reader service card

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD



FACT FILE

Dell OmniPlex 566

List price: \$7,227 **Processor/Memory:** Pentium/66, 32MB RAM, 256K external cache. **Data Storage:** Digital DSP3105 1GB SCSI hard disk with 512K cache, NCR 810 motherboard disk controller, Toshiba 3401 CD-ROM drive. **Display:** Integrated motherboard local-bus video controller with 2MB VRAM, Dell UltraScan 15FS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Windows 3.1. **In short:** Incredibly impressive and expensive, the Dell OmniPlex 566 uses the Pentium CPU to the fullest. It scored in the top ten of every test and took first place on three.

Dell Computer Corp.; 800-289-3355, 512-338-4400.

460 On reader service card

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	BELOW AVERAGE

stone scores were respectable though uninspiring.

In sum, the price of the VLB/Pentium 60 makes it worth looking into. For those users who are looking for a machine that is a little less expensive, this is a solid tower system that leaves the door open for future upgradability.—*BF*

Digital Equipment Corp.

DECpc XL 560

At first glance, the \$4,599 DECpc XL 560 looks just like a lot of other small tower systems in this roundup. But this well-built unit offers something that none of the others can—the option of a RISC-based future. When the parts become available, the modular DECpc XL will be able to use either a next-generation Intel CPU or a DEC Alpha-based processor card; so this machine can be either a PC or a RISC workstation.

The DECpc XL's motherboard supports PCI technology that ensures the PC won't be obsolete any time in the near future. Those users who feel that RISC

PC Buyer C'mon Down!



Get A Fortune Of Value

PC buyers jump for joy! You're entering the exciting and competitive game of computer buying! We know you want to finish first with high-performance PCs and prize-winning service at the most affordable prices in the industry. It's no contest – with Gateway 2000™ you'll always be the big winner!

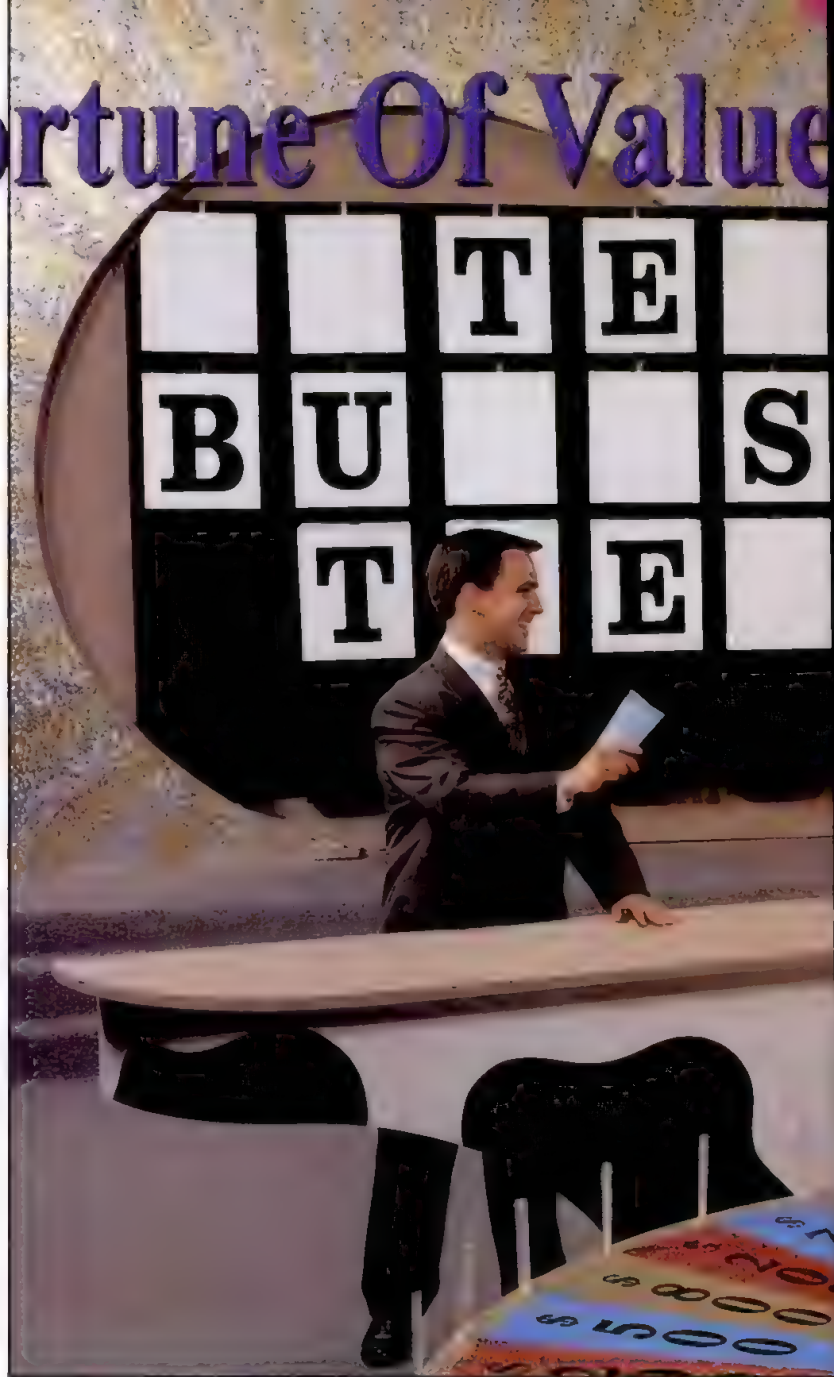
The Champ

And here are the stars of our show, Gateway's Pentium™-based systems! Starting from \$2,495 you get stupendous features. New lightning-fast hard drive systems! Screaming new graphics controllers on our two high-end P5 systems! Along with the most powerful Intel® processors available today! And (*drum roll please*) – all this at 486 prices!

Now in all four Gateway 2000 P5 systems, a new PCI/IDE controller allows the hard drive to transfer data *up to twice as fast* as non-PCI-based systems. The PCI/IDE controller is a major enhancement to Gateway's Intel Pentium processor and PCI local bus. Now you can access data faster than ever before!

Our P5-66 and top-of-the-line P5-60 now include high-end graphics controllers. So you can really take advantage of the performance-boosting PCI bus for virtually unbeatable graphics performance! These graphics controllers are also available as an upgrade option for all Gateway's PCI-based systems.

The standard graphics system on other Gateway PCI-based machines is another sure winner. You get 2MB standard graphics memory giving you 64,000 colors at 1024 x 768 resolutions. This graphics system uses a high-performance interface to graphics memory that achieves 16 million colors, true 24-bit, in VGA.



Been spinning your wheels on how to get tomorrow's technology today and still pay 486 prices? The puzzle is solved. With a price tag between \$2,495 and \$3,995, you'll hit the jackpot when you buy a Pentium-based system from Gateway 2000!

We also offer a full line of 486 PCI local-bus and integrated desktops systems. All are upgradable to a Pentium OverDrive™ Processor for the power you'll need in the future.

With Gateway 2000!



The Home Version

Fun and games are only part of what you get with the Gateway 4DX2-50 Family PC™. This special system includes full multimedia capabilities and software choices for the whole family. The Family PC brings productivity, education *and* entertainment into your home.



pentium
PROCESSOR



8 0 0 - 8 4 6 - 2 0 6 3

"X" Marks The Spot

Looking for the perfect portable PC? You'll get a celebrity performance when you choose Gateway 2000™ for the most value-packed portable PCs in the industry!



Gateway has all the right answers for incredible values with the ColorBook! Performance-enhancing features ... fast 486 processors and an incredibly big 10.3-inch screen on the DX4 model! ... make the ColorBook an undisputed champion.

Introducing the ColorBook DX4-75 with a faster-than-ever processor! This substantial power boost has made the DX4-75 the fastest 486 portable available today. And that's not all. For your extreme viewing pleasure, an extra-huge 10.3-inch dual-scan VGA color screen is now standard on the DX4. You won't find anyone else with a 10.3-inch screen at a better price.

All ColorBook models – 486SX-33, DX-33, DX2-50 and DX4-75 – have a host of great features. Weighing less than 5.7 pounds and measuring an ultra-thin 1.77 inches, the ColorBook supports simultaneous video; an easy-to-use, built-in trackball; two PCMCIA Type II slots; great battery life; and a suspend/resume feature so you can stop work anytime and resume later without losing data or restarting the system.

GATEWAY2000 HANDBOOK® 486

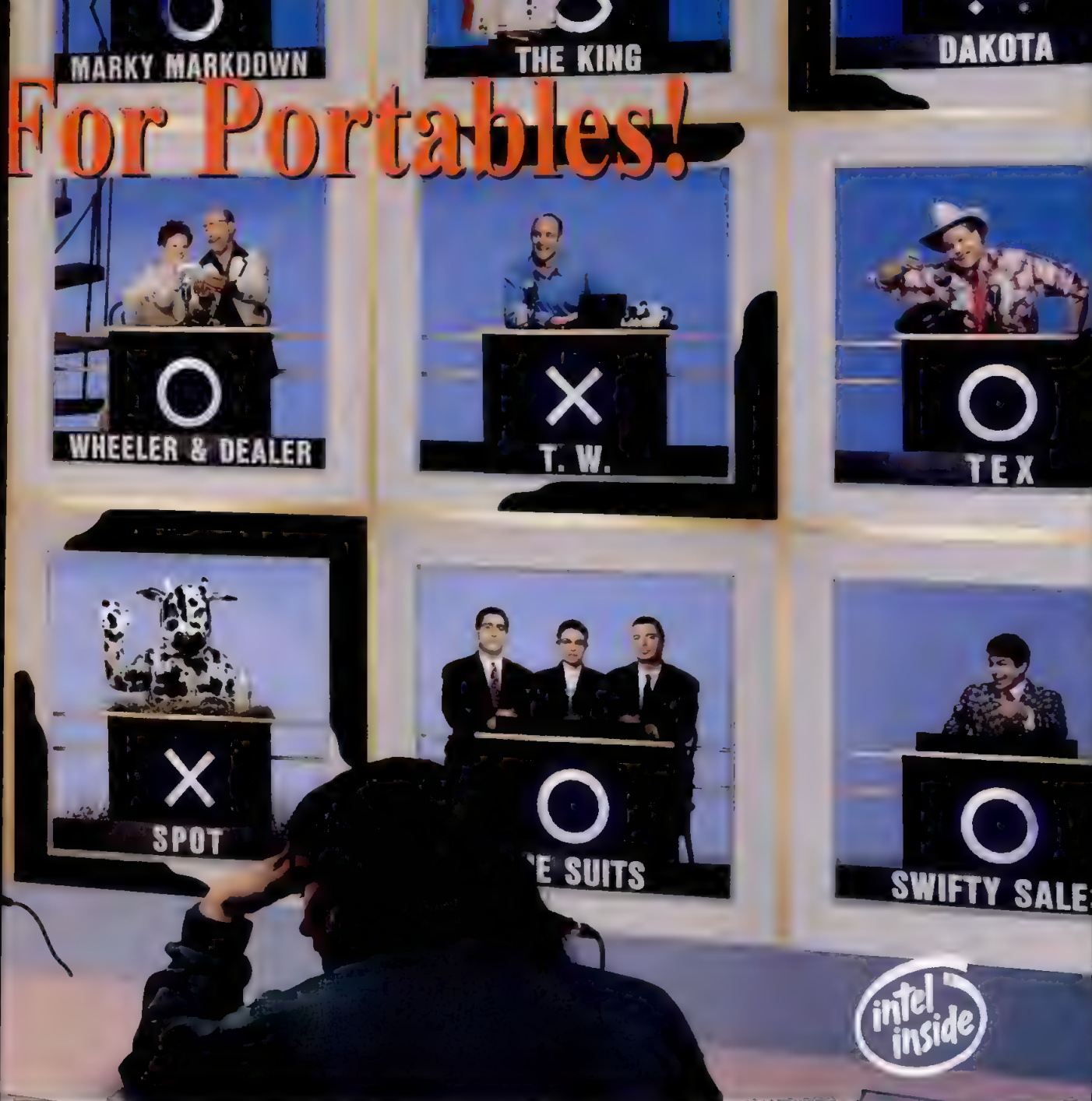
The revolutionary Gateway HandBook 486 is perfect for all your worldly travels. This powerful little performer will forever change the way you use a PC. And you won't have to think twice about taking it with you – no matter where you



go. It's a no-brainer. The HandBook is so small (*about the size of a day planner*) and so lightweight (*it's less than three pounds*) that you'll never want to be without it!

Unless you mind all the extra attention, as described by a leading columnist: "I almost got mobbed the other day on the train. I was doing what I usually do on the commute: writing on a notebook computer. The only difference was that I was using a Gateway 2000 HandBook 486 ... I can't wait until everyone has one. Then they'll leave mine alone."

For Portables!



The HandBook is a real PC with a powerful 486 processor; an IDE hard drive up to 130MB; standard 4MB or 8MB RAM upgradable to 20MB; a 7.9-inch bright, backlit VGA display screen; 78-key keyboard; EZ Point™ integrated pointer; excellent battery life; and suspend/resume feature.

Looking for a square deal on the best portables around? The odds are stacked in your favor with Gateway's ColorBook and HandBook portable PCs.



GATEWAY2000
"You've got a friend in the business."®

8 0 0 - 8 4 6 - 2 0 6 3

The Surveys Say...



Gateway 2000™ is the name of the game when it comes to the best service and support. The Gateway family is made up of hard-working Midwesterners who are dedicated to satisfying our customers. And although we're a Fortune 500 company, we haven't forgotten our simple philosophy of providing an honest value, a superior product and the best service possible. In return, Gateway's loyal customers are always there to cheer us on. But you don't have to just take our word for it. The surveys prove it!

All the talented people appearing in this ad are Gateway 2000 employees.

Hands Down Winner in Service and Reliability

A big thank you to readers of *PC Magazine* who responded to a Service and Reliability survey with impressive results: "In our latest survey, only Gateway 2000 gets our highest rating in both the desktop and laptop categories." The survey covered reliability, satisfaction with repair experience, satisfaction with technical support, and the likelihood of buying new PCs from the same vendor again.



PORTABLES

HANDBOOK® 486

- Weight: 2.94 Lbs.
- Dimensions: 9.75" x 5.9" x 1.6"
- SL Enhanced Intel® 486 Processor
- 4MB or 8MB RAM (expands to 20MB)
- 80 to 130MB IDE Hard Drive
- 7.9" Backlit VGA Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 1 PCMCIA Type II Slot
- EZ Point™ Integrated Pointer
- 78-Key Keyboard
- Parallel, Serial & PS/2 Ports
- MS Works for Windows™ 3.0
- MS-DOS 6.2, WFW 3.11 & Serial Transfer Cable

HANDBOOK

486SX-25

With 25MHz 486SX CPU, 4MB RAM and 80MB Hard Drive
\$1495

(with 130MB Hard Drive)

\$1595

HANDBOOK 486DX2-40

With 40MHz 486DX2 CPU, 8MB RAM, 130MB Hard Drive, Extra NiMH Battery, and Leather Carrying Case
\$2295

HANDBOOK

486SX-25

With 25MHz 486SX CPU, 8MB RAM, 130MB Hard Drive, and Leather Carrying Case
\$1895

PORTABLE OPTIONS

PCMCIA Cards:

- TelePath 14400/14400 fax/modem. **\$249**
- 9600/2400 fax/modem. **\$149**
- Ethernet adapter. **\$149**
- Token Ring adapter. **\$449**
- HandBook VGA adapter. **\$229**

Batteries:

- 2.2Ah NiMH batteries. **\$89**
- Alkaline battery pack. **\$29**

Diskette Drive:

- HandBook external 1.44MB. **\$99**

Cases:

- ColorBook **\$49**, HandBook **\$55**

Extended VIP Warranty:

- We'll ship a replacement within 24 hours during warranty. Point of sale only. **\$100**

COLORBOOK™

- Weight: Under 5.7 Lbs.
- Dimensions: 11.7" x 8.5" x 1.77"
- SL Enhanced Intel 486, DX2 or DX4 Processors
- 4MB or 8MB RAM (expands to 8, 12 or 20MB)
- 3.5" 1.44MB Diskette Drive
- Removable 120 to 250MB IDE Drive
- 10.3" or 9.4" VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
- Integrated Trackball (2 buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2® Ports
- External VGA Port
- MS Works for Windows 3.0
- MS-DOS 6.2 & WFW 3.11

COLORBOOK DX4-75

With 75MHz DX4 CPU, 8MB RAM, 250MB Hard Drive and 10.3" LCD
\$3495

COLORBOOK 486SX-33

With 33MHz 486SX CPU, 4MB RAM, 120MB Hard Drive and 9.4" LCD
\$1995

COLORBOOK DX-33

With 33MHz DX CPU, 4MB RAM, 170MB Hard Drive and 9.4" LCD
\$2495

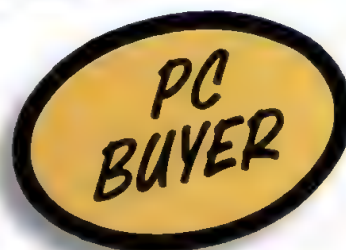
COLORBOOK DX2-50

With 50MHz DX2 CPU, 8MB RAM, 250MB Hard Drive and 9.4" LCD
\$2995

COLORBOOK PACKS

Traveler's Packs:

- Case, extra battery & PCMCIA 9600/2400 fax/modem. **\$279**
- Case, extra battery & PCMCIA TelePath fax/modem. **\$369**



SOFTWARE & EXTRAS

If a system comes with "choice of application software," choose one of the following packages:

- Microsoft Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf®, CD-ROM Edition
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- Microsoft Access™ for Windows
- Publisher's Pack (CD-ROM only; includes CorelDRAW 3,™ ArtShow, MS Publisher 2.0 & MS Design Pack)

- The Entrepreneur Pack (Works,™ Publisher,™ Money™ & games)
 - Borland Paradox® database and Quattro® Pro for Windows spreadsheet
 - Borland Paradox® and C++
- With desktop and selected portables you also get the following software and extras at no additional charge:
- MS-DOS 6.2 & Windows for Workgroups 3.11
 - CoSession™ Host Remote Diagnostics (with all modems)

- QAPLUS Diagnostics
 - Gateway Computer Glossary
 - Gateway Mouse Pad
- Systems with CDs also include:
- Gateway System CD
 - Multimedia On-Line User's Guide
 - Gateway Mall On-Line Catalog

SERVICE

Every Gateway system is backed by:

- 30-Day Money-Back Guarantee
- One-Year Limited Warranty
- Lifetime Toll-Free Technical Support
- On-Site Service Available To Most Locations
- Lifetime BBS Membership
- FaxBack Automated Fax Service

Our money-back guarantee does not include shipping. On-site service is provided at no charge during warranty if our technicians determine it is necessary. If you'd like to read our warranty and guarantee policies, please call for a free copy.



Printed on recycled paper with soy inks.

Gateway 2000 is a corporate sponsor of
GLOBAL RECYCLE



Ready For Action

Gateway 2000's friendly employees will take care of you from your first phone call throughout the life of your system with lifetime technical support. We've also made it easy for you to buy one of our world-famous PCs.



get a variable interest rate of 13.9% APR and a low \$18 annual fee.*

**Cash advance fee is \$1 plus 2% of the amount of the cash advance, but not less than \$5 nor more than \$10. Financing is available on approved credit with the Gateway DuoLine MasterCard, issued by Dial National Bank, Des Moines, Iowa.*

Internationally Known

Gateway 2000 also makes it easy for our neighbors in Canada and Puerto Rico to buy Gateway systems. You get the same award-winning technical support, CSA approvals, and on-site service that is available in most Canadian and Puerto Rican locations. Our international shipping rates are some of the most competitive in the industry. Canadian and Puerto Rican customers can reach us toll free at 800-846-3609. All other international customers can call us at 605-232-2000.

Our Family PC comes with a 14-inch CrystalScan monitor, 101-key keyboard, double-speed CD-ROM, sound card, speakers, joystick, fax/modem and multimedia software. You choose one software option from five great Family PC multi-title packages.



Easy Payment Options

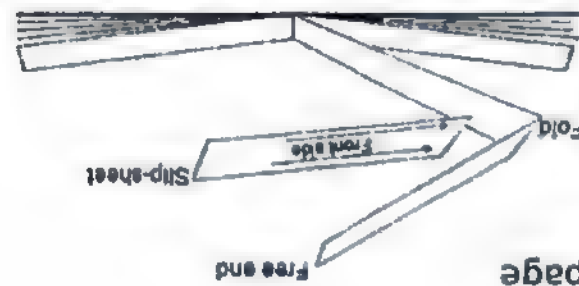
Gateway accepts most major credit cards and C.O.D. terms, with net 30-day terms and leasing options available to qualified commercial customers.

You can also apply for our new Gateway 2000 DuoLine MasterCard® Card, issued by Dial National Bank, which lets you make purchases from Gateway and anywhere else MasterCard is accepted by giving you two lines of credit — one for Gateway purchases and one for all other purchases. For Gateway purchases, the card has no annual fee and a low variable interest rate of just 12.9% APR. For other transactions, you



"You've got a friend in the business."®

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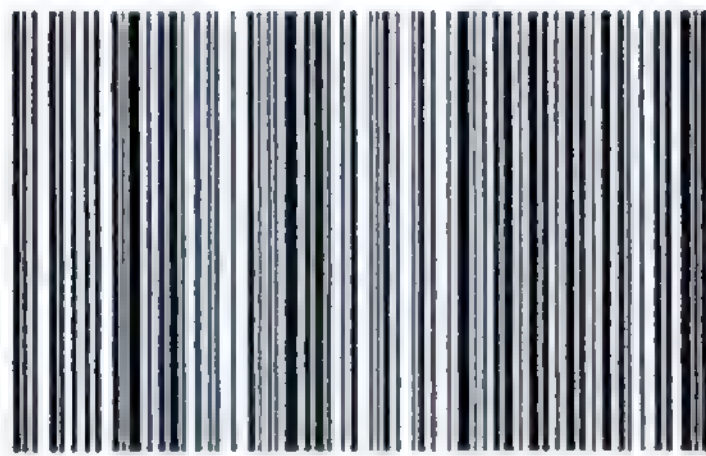
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Inverted Foldout slip-sheet



GbsSlipSheet-001



Foldout slip-sheet

Folded edge of the page

1. Open the foldout page

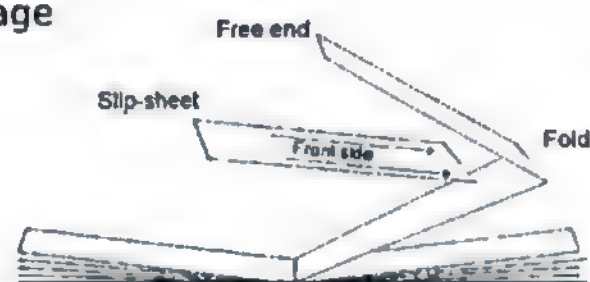
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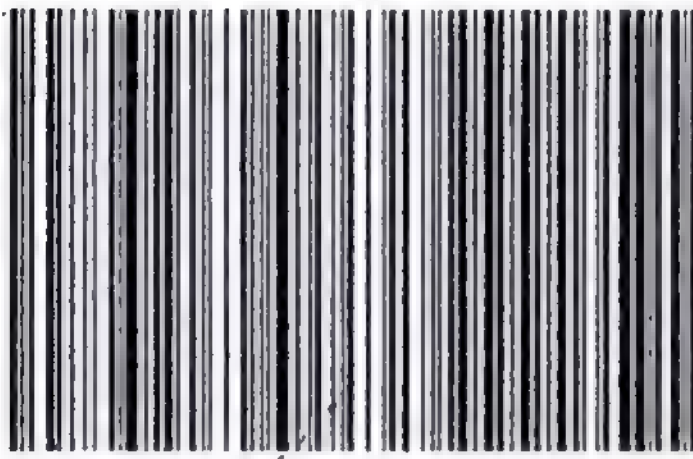
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4. Close the page and slip-sheet



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Inverted Back



GbsSlipBack-0018

Back

1. Follow instructions on the other side



World Class Winning

PC World's 1993 World Class Awards found readers honoring Gateway 2000 with top honors in five categories including Best Service and Support (for the second year in a row!) and Best Mail Order Company. Thank you, PC World readers!

Jesse Berst, editor of *Windows Watcher* was quoted in *PC World*: "Gateway has discovered an amazing secret, give people more for less and they are going to like you." We knew our secret wouldn't be safe for long!



Good Answers!

Computer Shopper summarized its readers' responses best: "Gateway, dominator of Best Buy balloting for the past three years, is your choice as Best Overall Supplier of computer systems ... For state-of-the-art PCs at bargain prices, North Sioux City is where Shopper readers look first." And "...Gateway 2000 has inspired a high degree of confidence and brand loyalty among Shopper's readers, who continue to rank Gateway's service and support as the best of all direct-channel PC vendors." Thanks Shopper readers!



INTEGRATED SYSTEMS

4SX-33

- Intel® 33MHz 486SX CPU
- 4MB RAM
- 212MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" Color CrystalScan® 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard & MS Mouse
- MS-DOS® 6.2 & WFW™ 3.11
- MS Works for Windows™ 3.0
- EPA Energy Star Compliant

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4DX-33

- Intel 33MHz 486DX CPU
- 4MB RAM
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- 3.5" Diskette Drive
- 14" Color CrystalScan® 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard & MS Mouse
- MS-DOS® 6.2 & WFW™ 3.11
- MS Works for Windows™
- EPA Energy Star Compliant

\$1495

4DX2-50 FAMILY PC™

- Intel 50MHz 486DX2 CPU
- 8MB RAM, 128KB Cache
- 212MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- Double-Speed CD-ROM, 16-Bit Sound Card & Speakers
- 2400/9600 Data/Fax Modem
- 3.5" Diskette Drive
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard, MS Mouse & Joystick
- Choice of Family PC Software
- EPA Energy Star Compliant

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MULTIMEDIA KIT

Here's everything you need to add multimedia to any Gateway desktop PC. You won't find a better price anywhere!

- Gateway 2000 16-Bit Sound Card, Sound Blaster™-Compatible
- Double-Speed CD-ROM
- 2 Labtec® Speakers
- Microsoft Encarta & Corel Photo CD Software

\$299

486 VESA & PCI SYSTEMS

4SX-33V

- Intel 33MHz 486SX CPU
- 4MB RAM
- 212MB 13ms IDE Hard Drive
- VLB™ Graphics with 1MB
- Local Bus IDE Interface
- 5.25" & 3.5" Combo Drive
- 14" Color CrystalScan® 1024NI
- Baby AT Case
- 5 ISA & 2 VESA®/ISA Slots
- AnyKey® Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software
- EPA Energy Star Compliant

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P4D-33

- Intel 33MHz 486DX CPU
- 8MB RAM, 256KB Cache
- 424MB 13ms IDE Hard Drive
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- Double-Speed CD-ROM
- PCI Fast IDE Interface
- 3.5" Diskette Drive
- 14" Color CrystalScan 1024NI
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- MS Works Multimedia Edition 3.0

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4DX2-66V

- Intel 66MHz 486DX2 CPU
- 8MB RAM, 128KB Cache
- 424MB 13ms IDE Hard Drive
- VLB Graphics with 1MB
- Double-Speed CD-ROM
- Local Bus IDE Interface
- 3.5" Diskette Drive
- 15" Color CrystalScan 1572FS
- Baby AT Case
- 5 ISA & 2 VESA/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software
- EPA Energy Star Compliant

\$2295

P4D-66 BEST BUY

- Intel 66MHz 486DX2 CPU
- 8MB RAM, 256KB Cache
- 540MB 13ms IDE Hard Drive
- PCI Local Bus Graphics with 2MB
- Double-Speed CD-ROM
- PCI Fast IDE Interface
- 3.5" Diskette Drive
- 15" Color CrystalScan 1572FS
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software

\$2495

PENTIUM SYSTEMS

P5-60

- Intel 60MHz Pentium™ CPU
- 8MB RAM, 256KB Cache
- 424MB 13ms IDE Hard Drive
- PCI Local Bus Graphics with 2MB
- PCI Fast IDE Interface
- 3.5" Diskette Drive
- 14" Color CrystalScan 1024NI
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- MS Works for Windows 3.0

\$2495

P5-60 BEST BUY

- Intel 60MHz Pentium CPU
- 8MB RAM, 256KB Cache
- 424MB 13ms IDE Hard Drive
- PCI Local Bus Graphics with 2MB
- Double-Speed CD-ROM
- PCI Fast IDE Interface
- 3.5" Diskette Drive
- 15" Color CrystalScan 1572FS
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software

\$2795

P5-60

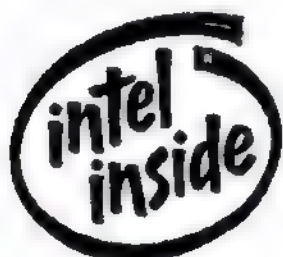
- Intel 60MHz Pentium CPU
- 16MB RAM, 256KB Cache
- 540MB 13ms IDE Hard Drive
- High-Performance PCI Local Bus Graphics with 2MB
- Double-Speed CD-ROM
- PCI Fast IDE Interface
- 3.5" Diskette Drive
- 15" Color CrystalScan 1572FS
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software

\$3295

P5-66

- Intel 66MHz Pentium CPU
- 16MB RAM, 256KB Cache
- 540MB 13ms IDE Hard Drive
- High-Performance PCI Local Bus Graphics with 2MB
- Double-Speed CD-ROM
- PCI Fast IDE Interface
- 16-Bit Sound Blaster-Compatible Sound Card & Yamaha Speakers
- 3.5" Diskette Drive
- 17" Color CrystalScan 1776LE
- Tower Case, 300W Power Supply
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software

\$3995



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610 Gateway Drive • N. Sioux City, SD 57049-2000 • Phone 605-232-2000 • TDD 800-846-1778 • Fax 605-232-2023 • FaxBack 605-232-2561 • Add-On Sales 800-846-2080 • Toll free from Canada and Puerto Rico 800-846-3609 • Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays(CST)

Extra Winnings

You'll score bonus points with the peripherals listed below, sold only with the purchase of a system from Gateway 2000. Call our special component add-ons division for our complete line of extras for Gateway customers.

Multimedia

Multimedia Kit

Here's everything you need to add multimedia to your Gateway PC:

- Gateway 2000™ 16-bit CD-quality sound card, compatible with Sound Blaster™ cards, with MIDI/game port, mic in, stereo line in/out
 - Double-speed CD-ROM drive, tray-loading, compatible with music CDs, multisession photo CDs and CD-ROM titles
 - 2 Labtec® speakers that can attach to your PC monitor
 - Microsoft® Encarta Multimedia Encyclopedia
 - Corel Professional Photo CD Sampler
- \$299**

Yamaha® YST-M10 Multimedia Speakers

The small speakers that sound big and come with a tiny price! This free-standing, self-powered speaker set is a great value!

\$75

Altec Lansing ACS-300 Multimedia Speakers

Get superior stereo sound with these top-rated Altec Lansing ACS-300 speakers with separate powered subwoofer. **\$219**

Communications & Storage

TelePath™ II Fax/Modem

Internal fax/modem, 14,400bps modem, V.32bis, with 14,400bps fax capability. Package includes data and fax communication software, plus a CompuServe® trial membership. **\$149**

Colorado Memory Systems® TBU

250MB internal automatic tape backup unit copies up to 9.5MB per minute. Comes with MS Windows™ and DOS® software, one tape and cable. **\$159**

Networking

Intel EtherExpress™

A 16-bit Ethernet adapter from a world leader in networking.

\$105 Twisted Pair or BNC

Ethernet Adapter from 3Com®

Manufactured by 3Com for Gateway.

\$105 Twisted Pair **\$125** BNC

Token Ring

IBM® 16-bit ISA Token Ring card. **\$429**

Monitors

CrystalScan® 17-Inch Monitor

Non-interlaced color monitor with intelligent multiscanning analog color display capable of ultra-high resolution up to 1280 x 1024 in non-interlaced mode and .26mm dot pitch.

Upgrade from a 14-inch monitor **\$430**

Upgrade from a 15-inch monitor **\$350**

(Prices good only for upgrades at the time of system purchase.)

Printers

Epson® Stylus 800 Ink Jet Printer

Great laser quality at an ever greater value. Measuring only 17 inches by 10.5 inches, the Stylus 800 has seven different typefaces and prints an extra-quiet 150 characters per second at 360dpi. Parallel cable included. **\$289**

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Add these peripherals to your new Gateway desktop, and you have everything you need for an efficient home office.

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\$399

processors are the future can buy now without worrying about losing their investment. The cooling system in the DECpc XL line is key because of the requirements of the Alpha chip. Digital Equipment Corp. shows its attention to detail with an airflow system that channels air to the processor.

In terms of performance, the 60-MHz DECpc XL was an above-average DOS performer though it lagged a little under Windows. The system's DOS-based video score was one of the best among those units using the Diamond Viper PCI card, and its Graphics WinMark score was on a par with these systems as well. DOS Disk and Disk WinMark scores were below average, which is interesting considering that DEC used an integrated controller with no cache. The DECpc XL's Winstone score was low compared to that of most other systems in this group.

The process of bridging the gap between CISC- and RISC-based systems is



► FACT FILE

DECpc XL 560

List price: \$4,599. **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache **Data storage:** Quantum 524MB IDE hard disk with 128K cache, integrated motherboard disk controller **Display:** Diamond Viper PCI local-bus-card video controller with 2MB VRAM, Digital PCXPB-VC 15-inch monitor with a 72-Hz refresh rate at 1024-by-768

Software: DOS 6.2,

Windows 3.1. **In short:**

If you believe that the future of computing lies in RISC, the DECpc XL 560 is a system that bridges the worlds of RISC workstations and PCs.

Digital Equipment Corp.: 800-722-9332, 508-493-5111.

462 On reader service card

SUITABILITY TO TASK

DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD

VENDOR SERVICE & RELIABILITY

Reliability	AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

■ Pentium for the Road

When the first Pentium chips emerged from Intel, speculation centered on how PC makers were going to get their hands on enough of the powerful processors. Now that there are plenty, Taiwanese notebook-maker Twinhead Corp. is getting into the act with a Pentium-powered notebook.

The gray developmental Slimnote P5/60T looks like any other notebook until it is turned on. The system's irritating fan noise and ventilation grate on the front are dead giveaways that there's something very hot inside. The system case remains cool in spite of the 60-MHz Pentium processor. The key is a quarter-inch high fan mounted on the CPU that runs continuously. In final revisions, engineers will add thermostatic control to increase battery life.

At a travel weight of 8.3 pounds, the Slimnote P5/60T is a notebook for those who don't want to leave power on their desk. With a VL-Bus graphics performance approaches that of a desktop Pentium PC. Other tests

place the Slimnote P5/60T between a 486DX2/66 notebook and a Pentium desktop. While this developmental unit performed well, the nickel hydride batteries lasted only 1 hour 15 minutes in continuous operation. This



\$6,000 powerful portable is expected to ship in March.—*Brian Nadel*

► FACT FILE

Slimnote P5/60T
Twinhead Corp., 800-995-8946, 408-945-0808.

List price: \$6,000 (estimated)

Configuration: Pentium/60, 8MB RAM, Toshiba 207MB MK2224FC hard disk, 9.4-inch Sharp active-matrix color display.

Circle 508 on reader service card

the first step toward confronting the real future of computers, and with the DECpc XL 560, another step has been taken.—*BF*

Duracom Computer Systems

Duracom DeskSaver Pentium-PCI

The \$7,249 Duracom DeskSaver Pentium-PCI is an aggressively configured machine that includes many extras but packs more of a punch in DOS than in Windows.

The DeskSaver tower holds a 1.2GB Toshiba SCSI-2 hard disk (the largest in this roundup), PCI-based video subsystem with a Number Nine GXE (based on S3's 86C928P-P chip set) video controller carrying 2MB of VRAM, and an additional 1MB of DRAM to total 3MB of video memory. On the other hand, most

of its benchmark test scores did not set it apart from many less-expensive machines in this group. This unit's S3 video chip set, which was used also in Mega Computer Systems' Mega Impact V-60PCI+, is noted for its powerful DOS performance as well as its anemic Windows throughput.

Not surprisingly, the DeskSaver logged the highest DOS video score and the second-highest DOSmark score. Under Windows, however, it turned in the lowest score on our Graphics WinMark tests and shared with the Austin Premier P5-60 Desktop the dubious honor of having the lowest Winstone score. The DeskSaver's 1.2GB hard disk and its ISA-based Duracom SCSI-2 controller allowed the unit to attain an above-average DOS disk score and an average Disk WinMark score.

The DeskSaver came with Number



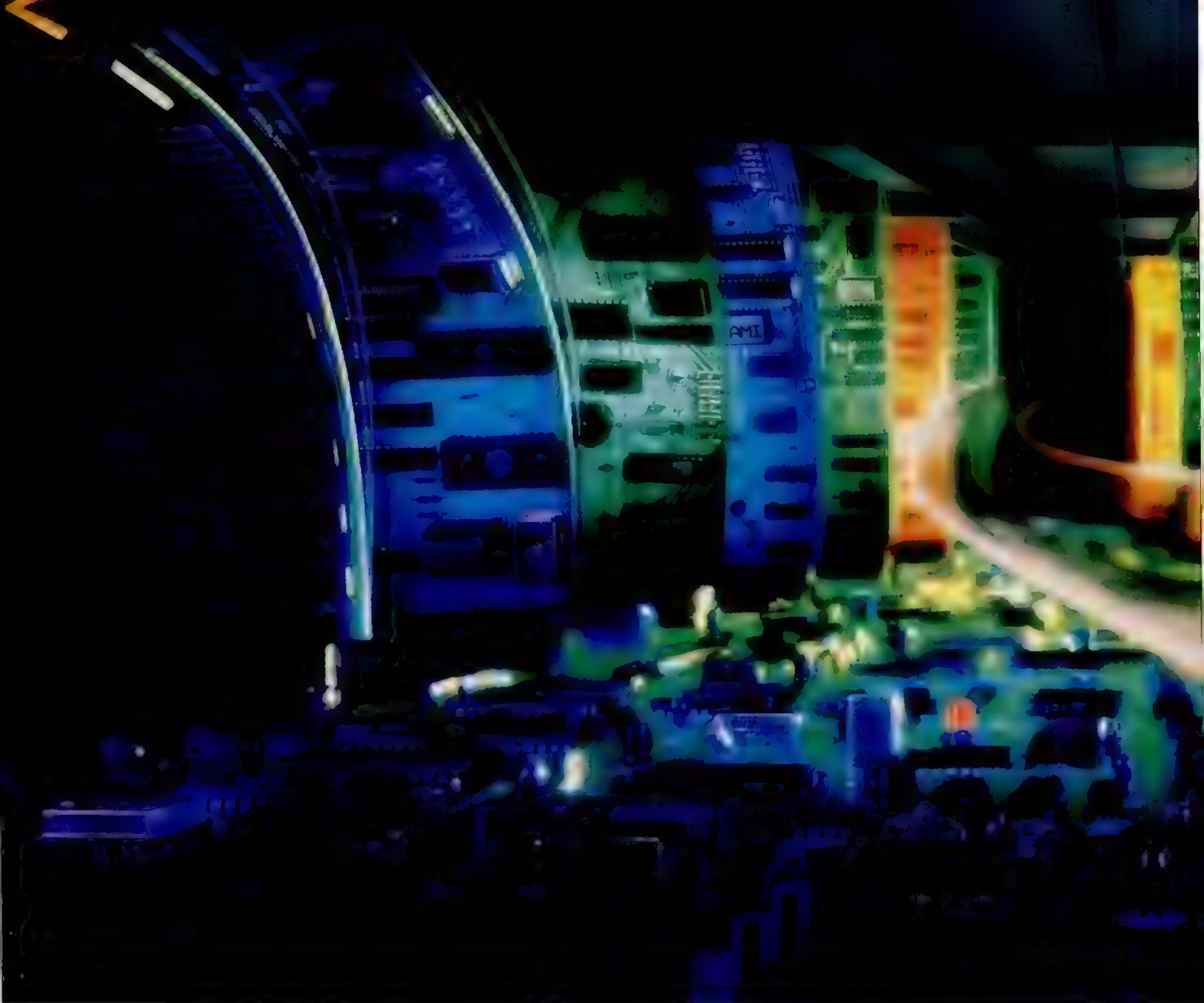
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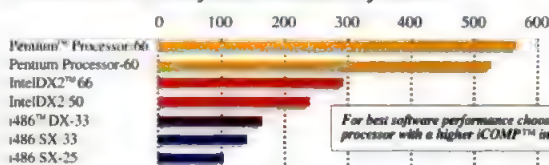
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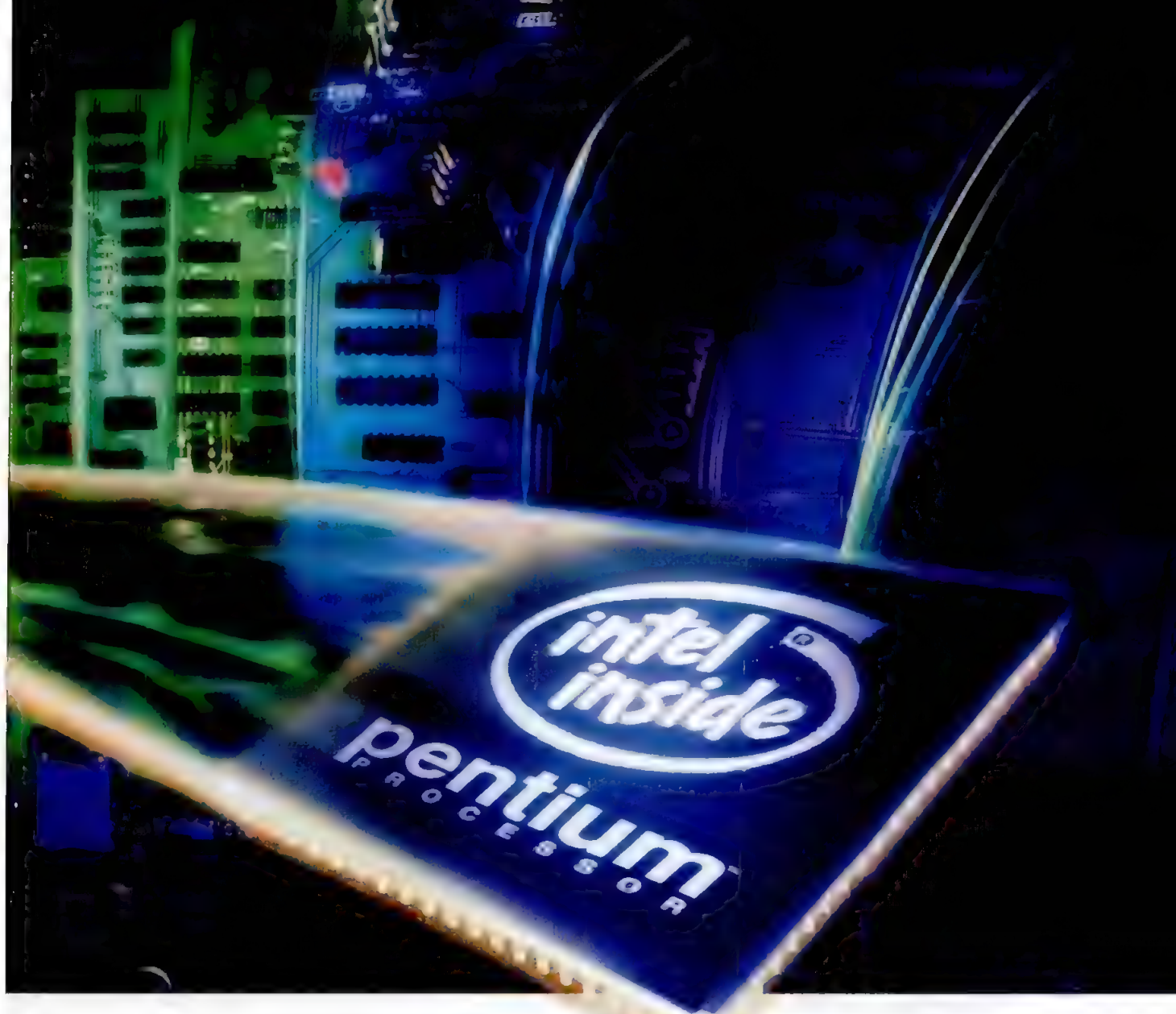
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PC MAGAZINE, Guide to Portable Computing, 8/93



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COMPUTER SHOPPER, This Powerbook Twin Acts Like a PC, 9/93



"The WinBook is a great example of what a Windows notebook should be...fast, easy-to-use and a miser on battery life...It's also inexpensive: nearly 50% less than some comparable notebooks."

WINDOWS MAGAZINE, Transcontinental Portable, 9/93

The WinBook Intel486 SX-25, DX-33 & DX2-50 SL Enhanced Features



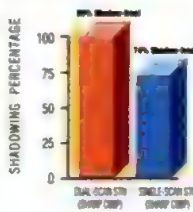
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The WinBook's unique ergonomic features include a sloping wrist rest and keyboard with full-size keys, plus a centered, dual-button trackball—allowing you to work in total comfort away from your desk.

Clear, sharp color display gives you near-active matrix quality at a passive matrix price!

Images are sharper and clearer with less cursor loss. And the WinBook's advanced dual-scan color display gives you 99% shadow-free performance compared to other single-scan passive matrix displays. You get a brighter, crisper, wider angle of view with an 18:1 contrast ratio—compared to

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to run much longer than units with traditional NiCAD batteries—and there's no memory effect!

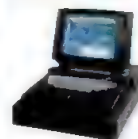


The WinBook offers you more features for less!

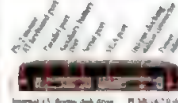
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SX & DX Specifications

- 11" x 8.5" x 1.5"
- SX monochrome, 5.4 lbs. with battery
- SX and DX dual-scan color, 5.9 lbs. with battery
- 16MB RAM (expandable to 32MB)
- 16MB hard drive (expandable to 32MB)
- 16MB hard drive (expandable to 32MB)
- 16MB hard drive (expandable to 32MB)
- 16MB hard drive (expandable to 32MB)

Battery

- SX-25: up to 3 hours with power management; over 5 hours with auxiliary power system (less 30 minutes for color)
- DX-33: over 2 hours with power management; up to 5 hours with auxiliary power system
- NiMH—no memory effect
- Workbooks auto-sensing AC adapter

Processor and Memory

- SX: enhanced Intel 486 SX 25MHz
- DX: 33MHz or DX2-50MHz CPU
- 4MB RAM (expandable to 32MB)
- Fast Power (Vega) IV chipset
- 32 internal cache

Display

- SX: monochrome, super-vented 64 gray scale 10" LCD
- SX and DX: color, dual-scan STN color display 9.5" LCD
- 640x480 resolution
- 512k video RAM up to 1024x768 resolution for external monitor
- Adjustable contrast and brightness
- Visible LCD illumination on completion
- Full-function keyboard with 85

Keyboard

- keys and 4 inverted-1 control control keys, 3.0mm keyboard
- 16MB hard drive (expandable to 32MB)
- 16MB hard drive (expandable to 32MB)
- 16MB hard drive (expandable to 32MB)
- 16MB hard drive (expandable to 32MB)

Mouse

- Fast 9600 baud send/4800 baud receive/2400 baud-fax-compatible
- PS/2 mouse interface (AT keyboard interface)
- PCMCIA type II slot
- Serial 9-pin connector

Options

- Parallel port
- Video 15-pin connector to external monitor
- 150-pin docking station
- Auxiliary battery port
- Docking station
- Car adapter
- 32MB RAM (expandable to 32MB)
- 32MB RAM (expandable to 32MB)

COVER STORY

Pentium PCs



► FACT FILE

Duracom DeskSaver Pentium-PCI

List price: \$7,249 **Processor/Memory:** Pentium/60, 32MB RAM, 256K external cache **Data storage:** Toshiba MK-538FB 1 2MB SCSI-2 hard disk with 512K cache, Duracom DC-800 ISA-card SCSI-2 disk controller with 16MB cache, Plextor DoubleSpeed CD-ROM DX-3028 **Display:** Number Nine #9GXE PCI local-bus-card video controller with 2MB VRAM and 1MB DRAM, ADI MicroScan 5A SM5517 17-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.0, Windows 3.1. **In short:** With the largest hard disk of all the units in this roundup, this pricey though well-equipped machine

excelled under DOS but lagged under Windows.

Duracom Computer Systems; 800-551-9000, 214-518-1200.

463 On reader service card

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD

Nine's Hawkeye for Windows display-control utility, which lets users easily make adjustments to the video card and to the 17-inch ADI monitor. For DOS aficionados, the DeskSaver's video subsystem offers clear advantages, but the unit's relatively high price is not matched by equally high overall performance.—Robert S. Anthony

Gateway 2000

Gateway 2000 P5-60

For those who find \$6,000, \$5,000, or even \$4,000 too high a price to pay for a Pentium system, enter the Gateway 2000 P5-60. Gateway has accomplished with its Pentium systems what it accomplished with its 486s: Its entry is once again among the least expensive units of the group.

What Gateway has done is put together a tower system with much of the same potential as the other systems in this roundup—but at a better price. Nine drive bays offer plenty of storage space.

Gateway did as Austin did—but with

better results—in sacrificing a little performance by using the Intel motherboard's integrated hard disk controller instead of the more-expensive PCI-based controller.

In general, our benchmark tests showed that while the P5-60 was an outstanding DOS performer, its Windows performance left much to be desired. The P5-60's DOSmark score was number two in this roundup, thanks mainly to the PCI-based ATI Mach32 video chip set, which also allowed this unit to place third on our DOS-based video tests. But this level of performance did not carry over to our Graphics WinMark tests, where the P5-60's score tied for second-to-last with that of the Novacor Novas, which uses a Tseng ET4000-based VL-Bus card. The P5-60's Winstone score was almost average, boosted by the unit's decent Disk WinMark score.

Gateway 2000 recognizes that its customers are willing to sacrifice a little on performance to save a lot on price.—BF



► FACT FILE

Gateway 2000 P5-60

List price: \$2,795 **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache **Data storage:** Western Digital Caviar 2540 540MB IDE hard disk with 128K cache, integrated disk controller, Mitsumi FX001D **Display:** ATI AXQ PCI local-bus-card video controller with 2MB DRAM, MAG InnoVision/Gateway CS1776LE 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.2, Windows 3.11, choice of one application. **In short:** In this unit, Gateway sacrificed Windows performance by using Intel's motherboard-integrated hard disk controller.

Gateway 2000; 800-846-2000, 605-232-2000.

464 On reader service card

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	FAIR
Expandability	GOOD

VENDOR SERVICE & RELIABILITY

Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Insight

Insight PCI P60 CD

The Insight PCI P60 CD's better-than-average price and flexible, well-thought-out design keep this system in contention despite its sometimes erratic performance on our benchmark tests.

The P60 CD, which is priced at \$3,599, arrived for testing with 16MB of easily accessible RAM (expandable to 128MB) and 256K of external cache. The expansion potential of Insight's full-tower system indicates that the P60 CD may have server



► FACT FILE

Insight PCI P60 CD

List price (tested configuration): \$3,599.

Processor/Memory: Pentium/60, 16MB RAM, 256K external cache **Data storage:** Quantum LPSS25 525MB IDE hard disk with 256K cache, Intel PCI/IDE local-bus-card disk controller, Mitsumi DoubleSpeed FX001D CD-ROM drive **Display:** ATI Mach32 PCI local-bus-card video controller with 1MB VRAM, CTX 1561 LR 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** The 60-MHz Insight PCI P60 CD almost has it all: a decent price, thoughtful design, 24-hour toll-free support, and express parts replacement.

Inconsistent performance test scores, however, did plague this system.

Insight; 800-729-0770, 602-902-1176.

465 On reader service card

SUITABILITY TO TASK

DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	EXCELLENT

aspirations. Of the unit's seven internal 3.5-inch bays, only one is occupied—by the 525MB IDE hard disk. The unit also has four 5.25-inch external bays available.

You'll find eight expansion slots in the P60 CD. The Intel PCI/IDE disk controller and the ATI Mach32 PCI video controller fill two of the three PCI slots. The only other card, the CD-ROM SCSI controller, takes up an ISA slot. Although five slots

are empty, one of the PCI slots and one of the ISA slots are located too close together to be used at the same time. But the total number of usable, unoccupied slots—four—is still more-than-adequate.

This system's benchmark test scores were disappointing. While the P60 CD's DOSmark and DOS video scores placed the unit in the top quarter of this group, its processor and Graphics WinMark scores placed it among the bottom five systems. All other scores were mediocre.

Insight backs up their highly expandable P60 CD with one year of free parts and labor, but you'll have to go to a third-party vendor to get on-site service.—Jodi L. Wynblatt

International Instrumentation Inc.

Blue Max Monolith Business Partner P5

The \$4,799 Blue Max Monolith Business Partner P5 has much to offer by way of expansion potential, overall performance, and features.



► FACT FILE

Blue Max Monolith Business Partner P5

List price: \$4,799. **Processor/Memory:** Pentium/60, 16MB RAM, 2MB external cache. **Data storage:** Conner CP30544 528MB IDE hard disk with 64K cache, Promise DC-4030VL-2 VESA local-bus-card disk controller with 4MB cache, Toshiba 3401B CD-ROM drive. **Display:** Diamond Viper VLB video controller with 2MB VRAM, Samsung SyncMaster 15C 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1.

In short: This unit had several scores at or near the peak of performance and contains lots of room inside for more peripherals.

International Instrumentation Inc.; 800-543-3475, 805-495-7673.

498 On reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	EXCELLENT

► SUMMARY OF FEATURES

CONTINUES

Pentium PCs

List price (tested configuration) We report the prices for the Pentium systems configured the way we tested them.

Hard disk capacity and interface describes the hard disk included in the tested system.

Dealers/Direct-distribution channel Some vendors sell only through authorized dealers or company-owned stores. Others sell their PCs directly to users via mail order or combine both methods.

DOS and Microsoft Windows included We asked all vendors to preinstall DOS and Microsoft Windows on their systems before shipping them to us. By the time you read this, most vendors will be shipping DOS 6.2, and many will be including Microsoft Windows for Workgroups 3.11 as the standard system software.

Bus architecture (primary, secondary) refers to the buses that connect the I/O slots to the CPU. For this roundup, we required all of the Pentium PCs to have a secondary local-bus architecture in addition to the primary ISA or EISA bus.

Processor upgrade path Processors can be seated in several different types of sockets, which determine a computer's CPU upgradability. These sockets can be standard, LIF (low insertion force), or ZIF (zero insertion force).

We indicate the **BIOS version (or date)** for each system. The BIOS, which performs a computer's initial boot and test routines, may affect a unit's performance on our benchmark tests.

Flash memory stores the BIOS code, replacing conventional ROM storage for this purpose. Unlike ROM, flash memory can handle both reads and writes, making the BIOS upgradable.

Although International Instrumentation's system has four SIMM sockets, only two of them were used in the tested 16MB configuration. To double the RAM, you won't have to replace any of the existing SIMMs, but the maximum RAM of 128MB can be attained only by replacing all of the sockets with 32MB SIMMs. An added bonus is the system's

External RAM cache We list the range of external RAM cache the computer can support.

Cache architecture In a direct-mapped cache, each address in main memory is assigned to one location in the cache. Each location in the cache, however, can accept data from many main memory addresses—though not from more than one at once. This one-to-many relationship between main memory and cache often results in bottlenecks. Two-way set-associative caches relieve this problem somewhat by allowing each address in main memory to occupy one of two locations in the cache; the penalty is that the cache must be searched to find in which of the two locations data is located. Four-way set-associate cache is similar, with each address in main memory corresponding to four locations in the cache.

Cache write design Write-through caches write updated data to both cache and main memory. Although relatively easy to implement, write-through cache can introduce delays. For write-back cache, data that has been changed is written back to the cache; main memory is updated only when the cached data is replaced, thus minimizing delays. Buffered write-through cache stores data in buffers until the system bus is free.

The **disk controller interface** refers to the type of bus used to connect the CPU to the disk controller circuitry, which is either located on a card or integrated onto the motherboard.

CD-ROM drive For those tested systems that included a CD-ROM drive, we indicate the drive manufacturer and model.

The **display circuitry interface** refers to the type of bus used to connect the display logic to the CPU. This circuitry is either located on a card or integrated onto the motherboard.

whopping 2MB of external processor cache.

Of its eight expansion slots, one VL-Bus slot and three ISA slots remain empty. The 8-bit I/O card, 8-bit SCSI card, Promise DC-4030VL-2 VL-Bus disk controller, and Diamond Viper VLB card occupy the other slots. One internal 5.25-inch drive bay and two available external

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▼ SN-Series

▼ N-Series

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SN425C

- 486SX, 25 MHz, SL-Enhanced
- 4MB RAM, max: 20MB
- 170MB removable hard disk
- 7.8" STN color screen
- 1 PCMCIA slot, Type II
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- 4MB RAM, max: 20MB
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- 8.2" monochrome LCD
- 1 PCMCIA slot, Type II
- 86-key keyboard
- Integrated 16mm trackball
- MS-DOS, Windows 3.1
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- 3.5" 1.44MB diskette drive
- 200MB hard disk
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- 1 PCMCIA slot, Type III
- 86-key keyboard
- Integrated 16mm trackball
- MS-DOS, Windows 3.1
- Carrying case
- 6.6 lbs, including battery

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N450C

- 486DX2, 50 MHz
- 4MB RAM, max: 12MB
- 3.5" 1.44MB diskette drive
- 200MB hard disk
- 9.5" DSTN dual-scan color screen
- 1 PCMCIA slot, Type III
- 86-key keyboard
- Integrated 16mm trackball
- MS-DOS, Windows 3.1
- Carrying case
- 6.6 lbs, including battery

\$2,599

N433C

- 486SX, 33 MHz
- 4MB RAM, max: 12MB
- 3.5" 1.44MB diskette drive
- 120MB hard disk
- 9.5" DSTN dual-scan color screen
- 1 PCMCIA slot, Type III
- 86-key keyboard
- Integrated 16mm trackball
- MS-DOS, Windows 3.1
- Carrying case
- 6.6 lbs, including battery

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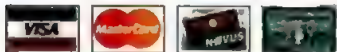
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► SUMMARY OF FEATURES

CONTINUES

Pentium PCs

Products listed in alphabetical order ■ = YES □ = NO								
List price (tested configuration)	\$5,388	\$3,697	\$3,399	\$5,545 (estimated)	\$3,995	\$2,795	\$4,598	\$4,999
Processor type and speed	Pentium/66	Pentium/60	Pentium/60	Pentium/60	Pentium/60	Pentium/60	Pentium/66	Pentium/60
Hard disk capacity and interface	527MB IDE	528MB IDE	546MB Fast SCSI-2	494MB IDE	340MB IDE	424MB IDE	322MB IDE	456MB Fast SCSI-2
Dealers/Direct-distribution channel	■ ■	□ ■	■ ■	■ □	■ ■	□ ■	□ ■	■ ■
Case style	Desktop	Desktop	Tower	Slimline	Tower	Desktop	Tower	Mini-tower
Power supply (and number of connectors)	200W (4)	200W (5)	250W (8)	145W (4)	250W (7)	200W (5)	250W (4)	230W (6)
DOS and Microsoft Windows included	■	■	■	■	■	■	■	■
Warranty	5 years parts, 15 months labor	1 year	1 year	3 years	1 year	2 years	1 year	1 year parts, 5 years labor
On-site service charge	\$9.95 (1 year)	Included (1 year)	N/A	Included (1 year)	\$68 (1 year)	Included (1 year)	Included (1 year)	\$199 (1 year)
Processor and Memory								
Bus architecture (primary, secondary)	ISA, VL-Bus	ISA, PCI	ISA, PCI	ISA, PCI	ISA, PCI	ISA, PCI	ISA, VL-Bus	ISA, VL-Bus
Motherboard manufacturer	ALR	Intel	Intel	Intel	ATronics	Intel	Axix	TMC
Chip set manufacturer	OPTi	Intel	Intel	Intel	Intel	Intel	OPTi	OPTi
Processor upgrade path	None	ZIF	Standard	ZIF	Standard	ZIF	ZIF	Standard
BIOS version (or date)	Phoenix 1.02.01m	AMI (12/3/93)	Award (1/1/93)	AMI (10/22/93)	Award (1/1/93)	AMI 1.00.03.AF1	AMI (11/11/92)	AMI OP-WBt-60166
Flash memory/16550 UART support	■ □	■ ■	■ □	■ ■	□ □	■ ■	□ ■	□ □
Installable system RAM	8MB-128MB	8MB-128MB	4MB-192MB	16MB-128MB	4MB-192MB	8MB-128MB	4MB-128MB	2MB-128MB
External RAM cache	256K	256K	256K-512K	256K	256K-512K	0-256K	128K-512K	128K-512K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-through	Buffered write-through	Write-through	Write-back	Write-through	Write-back	Write-back
Components								
Available hard disk sizes	210MB-535MB	340MB-1GB	340MB-1.2GB	340MB-1GB	120MB-1GB	250MB-525MB	234MB-2.1GB	130MB-3.3GB
Disk controller interface, location	VL-Bus, card	PCI, card	PCI, card	Proprietary, motherboard	PCI, card	PCI, motherboard	VL-Bus, card	VL-Bus, card
Accessible drive bays (5.25", 3.5")	2, 1	3, 1	4, 0	2, 1	6, 0	3, 0	4, 0	3, 2
Internal drive bays (5.25", 3.5")	0, 1	0, 2	3, 0	0, 1	0, 3	0, 2	2, 4	0, 2
Floppy disk drives	1.44MB	1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
CD-ROM drive	Plextor DM-3028	Philips 206 2X	Sony CDU-561	Toshiba 3401B	Toshiba 3401B	Sony CDU-33A	NEC MultiSpin 3Xi	NEC MultiSpin 3Xi
ISA, EISA, MCA slots	3, 0, 0	5, 0, 0	5, 0, 0	3, 0, 0	5, 0, 0	5, 0, 0	5, 0, 0	5, 0, 0
VL-Bus, PCI, proprietary local-bus slots	3, 0, 0	0, 3, 0	0, 3, 0	0, 2, 0	0, 3, 0	0, 3, 0	3, 0, 0	3, 0, 0
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
Display circuitry interface, location	VL-Bus, card	PCI, card	PCI, card	Proprietary local bus, motherboard	PCI, card	PCI, card	VL-Bus, card	VL-Bus, card
Video chip set manufacturer	Matrox	Weitek	Weitek	ATI	Weitek	Weitek	Weitek	Weitek
Video RAM	2MB	2MB	2MB	1MB	2MB	2MB	2MB	2MB

N/A—Not applicable: The product does not have this feature.

ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., ECS—Elitegroup Computer Systems Inc., SIC—SIC Research, SVC—Silicon Valley Computer, TMC—TMC Research.

drive bays mean there is plenty of room for additional components.

This unit had two performance bright spots: its third-place DOS disk score and its second-place Disk WinMark score. The latter translated into a Winstone score that placed this system in the top third of the group. Unfortunately, the Blue Max BP P5's DOSmark score was lower than that of nineteen other systems because of a disappointing showing on our DOS video tests.

While slightly overpriced, this machine offers a mix of performance and features that is likely to excite.—JLW

Mega Computer Systems

Mega Impact V-60PCI+

If your daily computing tasks are not Windows-intensive, you might want to consider Mega Computer Systems' \$3,795 60-MHz Mega Impact V-60PCI+, which combines strong performance under DOS with room to expand.

The Impact's mini-tower came loaded with 16MB of RAM (expandable to 128MB), a 342MB Conner IDE disk drive paired with an Intel PCI local-bus con-

troller card, and Intel's S3-based PCI video board with 1MB of VRAM, which contributed to the unit's high DOS video score but wasn't quite up to par under Windows. Expansion slots in this system are plentiful. Five ISA slots are provided, one of which was filled by a Spectrum 16 sound card in our test unit; the system also has three PCI slots, although two were filled to meet our test configuration.

This unit includes a Toshiba double-speed CD-ROM, 200-watt power supply with six connectors, and motherboard-integrated communications (16550 UART is supported). The only design

drawback seems to be the location of the SIMM slots, which are blocked by the drive bay casing, necessitating the casing's removal for memory upgrades.

The highlights of this unit's benchmark test performance were definitely in the DOS arena. Although this unit's DOS

future growth: four open 16-bit ISA slots, an open PCI local-bus slot, open external drive bay, and open internal drive bay. While the system's dual floppy disk drive was connected directly to the motherboard, its 528MB Maxtor IDE hard disk was connected to a Tekram PCI-based controller card with a generous 16MB of cache.

The Powerstation achieved its performance highlight via this disk subsystem, taking first place with its DOS disk score and third place with its Disk WinMark score. Using a video subsystem that has a Diamond Viper PCI adapter card with 2MB of video memory and a Weitek Power 9000 chip set, this unit posted an above-average score on our Graphics WinMark tests; its DOS video score, however, was just below average. The Powerstation's DOSmark, processor, and Winstone scores were about average.

In terms of disk-intensive computing, the Powerstation offers a great deal of power in a sleek, compact package. Its overall performance, however, didn't outshine that of other less-expensive machines in this roundup.—RA



► FACT FILE

Mega Impact V-60PCI+

List price: \$3,795 **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache **Data storage:** Conner CP30344 342MB IDE hard disk with 64K cache, Intel PCI/IDE PCI local-bus-card disk controller, Toshiba 3401B CD-ROM drive **Display:** Intel PCIS3928 PCI local-bus-card video controller with 1MB VRAM, MGC 1506-XGA 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Windows 3.1 **In short:** This relatively inexpensive machine—the Mega Impact V-60PCI+—produced strong DOS scores; its

Windows scores, however, were all slightly below average.

Mega Computer Systems; 800-338-6628, 619-497-8888.

467 On reader service card

SUITABILITY TO TASK

DOS applications **EXCELLENT**

Windows applications **FAIR**

Expandability **FAIR**

disk score was barely average, it placed second on our DOS video tests, and its DOSmark score was fifth best of the group. On the Windows side of the house, the Impact's scores were all slightly below average; its Winstone score was particularly low.—Carol Venezia

Micron Computer Inc.

Micron P60PCI Powerstation

While the \$4,958 Micron P60PCI Powerstation from Micron Computer showed stellar performance on our hard disk benchmark tests, the 60-MHz Pentium system, as a whole, was unable to stand out from the crowd.

The tightly packed interior of the Powerstation's desktop case provided enough expansion room for moderate



► FACT FILE

Micron P60PCI Powerstation

List price (tested configuration): \$4,958 **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache **Data storage:** Maxtor MXT-540A 528MB IDE hard disk with 256K cache, Tekram DC-690 PCI local-bus-card disk controller with 16MB cache, Mitsumi FX1001D CD-ROM drive **Display:** Diamond Viper PCI local-bus-card video controller with 2MB VRAM, MAG MX17F 17-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Windows 3.1 **In short:** This unit posted top disk scores, but its otherwise average performance makes its price of \$4,958 seem a bit high.

Micron Computer Inc.; 800-388-6334, 208-465-3434.

468 On reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **FAIR**

Mitsuba Corp.

Mitsuba Professional Pentium

Mitsuba Corp.'s \$3,895 Mitsuba Professional Pentium falls somewhat short in terms of component integration and system design, but its price is one of the more reasonable in this group.

Open up the Professional Pentium's voluminous tower case, and you'll find an upgradable 60-MHz Pentium; six ISA slots, two with VL-Bus extensions; a 340MB Conner hard disk paired with a Promise disk controller card carrying a whopping 8MB of caching controller memory; local-bus video powered by Tseng Laboratories'



► FACT FILE

Mitsuba Professional Pentium

List price: \$3,895 **Processor/Memory:** Pentium/60, 16MB RAM, 512K external cache **Data storage:** Conner CFA340A 342MB IDE hard disk with 64K cache, Promise DC-4030VL VL-Bus-card disk controller with 8MB cache, Mitsumi CRMCD CD-ROM **Display:** Mitsuba GP4530 VL-Bus video controller with 1MB DRAM, Mitsuba M15VS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1 **In short:** Disappointing performance combined with an awkward, poorly designed interior to mar this powerfully

justified entry—the Mitsuba Professional Pentium.

Mitsuba Corp.; 800-648-7822, 909-392-2000

469 On reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **POOR**

ET4000/W32i chip set; and a 300-watt power supply with 11 connectors.

For such a "spacious" system, this unit has virtually no expansion potential. Its two VESA slots are filled by the video board and disk controller card, and two of its four ISA slots are occupied by a board for the Mitsumi CD-ROM and an I/O connector card. The remaining two ISA slots are blocked—one by the I/O card's

► **S U M M A R Y O F F E A T U R E S**

CONTINUES

PC MAGAZINE
EDITORS' CHOICE

Products listed in alphabetical order

■ = YES □ = NO

	Compaq Deskpro XE 560 Model 525/W	Cornell P5-60 PCI	Dell OmniPlex 566	Diamond DT VL8/Pentium-60	Digital DECpc XL 560	Duracom DeskSaver Pentium-PCI	Gateway 2000 P5-60	Insight PCI P60 CD
List price (tested configuration)	\$5,128 (estimated)	\$4,095	\$7,227	\$3,849	\$5,297	\$7,249	\$2,795	\$3,599
Processor type and speed	Pentium/60	Pentium/60	Pentium/66	Pentium/60	Pentium/60	Pentium/60	Pentium/60	Pentium/60
Hard disk capacity and interface	527MB IDE	545MB Fast SCSI-2	1GB Fast SCSI-2	344MB SCSI	524MB IDE	1.2GB Fast SCSI-2	540MB IDE	525MB IDE
Dealers/Direct-distribution channel	■ ■	■ ■	■ ■	□ ■	■ ■	■ □	□ ■	□ ■
Case style	Slimline	Tower	Desktop	Tower	Mini-tower	Tower	Tower	Tower
Power supply (and number of connectors)	145W (4)	300W (9)	224W (5)	250W (8)	300W (6)	250W (9)	300W (6)	230W (10)
DOS and Microsoft Windows included	■	■	■	■	■	■	■	■
Warranty	3 years	3 years	1 year	15 months parts, 2 years labor	3 years	3 years	1 year	1 year
On-site service charge	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (3 years)	N/A	N/A
Processor and Memory								
Bus architecture (primary, secondary)	ISA, proprietary local bus	ISA, PCI	EISA, PCI	ISA, VL-Bus	ISA, PCI	ISA, PCI	ISA, PCI	ISA, PCI
Motherboard manufacturer	Compaq	Asus	Dell	SIC	Digital	Intel	Intel	Intel
Chip set manufacturer	Compaq	Intel	Intel	OPTi	Intel	Intel	Intel	Intel
Processor upgrade path	Standard	Standard	Standard	Standard	Processor card	ZIF	None	ZIF
BIOS version (or date)	Compaq (9/28/93)	Award (1/1/93)	Intel 28FO01B	AMI (10/19/93)	Phoenix (8/28/93)	AMI (11/11/92)	AMI (9/24/93)	AMI (9/20/93)
Flash memory/16550 UART support	■ ■	■ □	■ ■	□ □	■ ■	■ ■	■ ■	■ ■
Installable system RAM	8MB-136MB	2MB-192MB	8MB-192MB	1MB-128MB	4MB-192MB	2MB-128MB	1MB-32MB	1MB-128MB
External RAM cache	0-256K	256K-512K	256K	256K-2MB	256K	128K-256K	256K	0-256K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Four-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-through	Write-back	Write-back	Write-through	Write-through	Write-back	Write-through	Write-back
Components								
Available hard disk sizes	270MB-525MB	520MB-4GB	210MB-2GB	340MB-2GB	127MB-1GB	250MB-1.7GB	212MB-1GB	525MB-9GB
Disk controller interface, location	Proprietary, motherboard	PCI, card	Proprietary, motherboard	VL-Bus, card	Proprietary, motherboard	SCSI, card	Proprietary, motherboard	PCI, card
Accessible drive bays (5.25", 3.5")	1, 1	6, 0	3, 0	4, 0	3, 1	4, 0	4, 1	4, 1
Internal drive bays (5.25", 3.5")	0, 1	0, 0	0, 1	2, 3	0, 1	0, 3	0, 4	0, 7
Floppy disk drives	1.44MB	1.44MB	Dual 1.2MB/1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB, 1.44MB	1.44MB	1.44MB
CD-ROM drive	Compaq	Toshiba 3401B	Toshiba 3401B	Toshiba 3401B	Toshiba 3401B	Plextor DX-3028	Mitsumi FX001D	Mitsumi FX001D
ISA, EISA, MCA slots	4, 0, 0	5, 0, 0	0, 5, 0	5, 0, 0	4, 0, 0	5, 0, 0	5, 0, 0	5, 0, 0
VL-Bus, PCI, proprietary local-bus slots	0, 0, 1	0, 3, 0	0, 2, 0	3, 0, 0	0, 3, 1	0, 3, 0	0, 3, 0	0, 3, 0
Parallel, serial, mouse ports	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 1	2, 3, 0	1, 2, 1	1, 2, 1
Display circuitry interface, location	Proprietary local bus, motherboard	PCI, card	Proprietary local bus, motherboard	VL-Bus, card	PCI, card	PCI, card	PCI, card	PCI, card
Video chip set manufacturer	Compaq	Weitek	ATI	Weitek	Weitek	S3	ATI	ATI
Video RAM	1MB	2MB	2MB	2MB	2MB	3MB	2MB	1MB

N/A—Not applicable. The product does not have this feature.

ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., ECS—Elitegroup Computer Systems Inc., SIC—SIC Research, SVC—Silicon Valley Computer, TMC—TMC Research

cables, the other by memory chips on the controller card. In an age of tightly integrated motherboards, the Mitsuba professional has taken a step backward.

The Professional Pentium's performance on our benchmark tests was spotty. Its only bright spots were its DOS video score—which nearly doubled the average—and its DOSmark score. But the DOS disk score was surprisingly low in light of the unit's substantial hardware. The system's Winstone and Disk WinMark scores were competitive, but its Graphics WinMark score was below average.—CV

National MicroComputers

NMC Expert System P60

Although National MicroComputers may have missed the boat with some aspects of its NMC Expert System P60, it still produced a PC with solid performance scores and room for expansion. But at \$5,553, the price is a bit hefty.

The Expert System P60 is based on a 60-MHz Pentium CPU. The unit's ISA bus has seven expansion slots, two with VL-Bus extensions. Both VL-Bus slots

are occupied, one by a Hercules Dynamite PBDVL video card carrying 2MB of DRAM and using Tseng Laboratories' ET4000/W32i chip set; the other VL-Bus socket contains an Alpha Research DC880 disk controller card with 8MB of cache memory wired to a 545MB Maxtor SCSI-2 hard disk. The Expert System P60's ECS motherboard can accommodate up to 128MB of RAM.

The unit's only design faux pas is its use of an ISA slot for an I/O card. Granted, this still leaves four slots open, but other reviewed systems take the more effective and space-saving route of using an inte-

grated motherboard for I/O support.

On our benchmark tests, the Expert System P60 better earned its moniker on our DOS tests than it did on our Windows tests. It especially shined on our DOS video tests, where it produced an above-average score. The system's DOSmark score was also very strong. On Windows-based tests, the Expert was a consistently average performer.



FACT FILE

NMC Expert System P60

List price: \$5,553. **Processor/Memory:** Pentium/60, 32MB RAM, 512K external cache. **Data storage:** Maxtor MXT-540S 545MB SCSI-2 hard disk with 256K cache, Alpha Research DC880 VL-Bus-card disk controller with 8MB cache, Toshiba 3401B CD-ROM drive. **Display:** Hercules Dynamite PBDVL VL-Bus-card video controller with 2MB DRAM, ADI MicroScan 4G 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024. **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** Priced in the upper range of this roundup, the NMC Expert

System P60 was a solid performer under both DOS and Windows.

National Micro-Computers, 800-424-2983, 801-265-3700.

470 On reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD

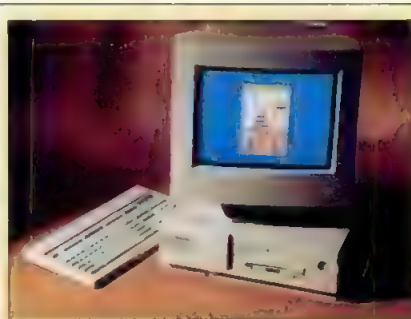
The Expert System P60 is covered by a one-year parts, two-years labor warranty. On-site service is an additional \$39 per year.—CV

NEC Technologies Inc.

NEC Image P60

The NEC Image P60 is a well-integrated PC with components that go beyond the call of duty and an excellent warranty. At \$5,386, however, this unit is pricey, and its benchmark test scores do not warrant the extra expense.

Inside the Image P60's desktop case, you'll find a 60-MHz Pentium CPU in an upgradable ZIF socket. But you'll have to



FACT FILE

NEC Image P60

List price (tested configuration): \$5,386. **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache. **Data storage:** Western Digital 2540 540MB IDE hard disk with 256K cache, integrated disk controller with 256K cache, NEC MultiSpin 3Xi CD-ROM drive. **Display:** Diamond Viper PCI local-bus-card video controller with 2MB VRAM, NEC MultiSync 5FGe 17-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024.

Software: DOS 6.0, Microsoft Windows 3.1. **In short:** The NEC Image P60's performance scores do not justify its somewhat high price.

NEC Technologies Inc.; 800-388-8888, 508-264-8000.

471 On reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

look hard, because the CPU sits on a section of the motherboard that is blocked by the drive bay casing, necessitating the drive bay's removal if you wish to upgrade. Memory upgrades will be no easier: To access the unit's two SIMM banks, the PCI/EISA backboard—a vertically mounted riser card that holds the unit's expansion slots—must be removed.

The Image P60 also contained a 540MB disk drive with 256K cache, 16MB of system RAM, three EISA slots, and two PCI slots. One PCI slot and all three EISA slots are available; one PCI slot holds a Diamond Viper card with 2MB of VRAM and powered by the Weitek Power 9000 chip—which, to our surprise, did not help this unit at all on our Graphics WinMark tests.

On our benchmark tests, the Image P60's only above-average showing was on our DOS video and Graphics WinMark tests. Its processor score was average, and its Winstone performance was particular-

ly disappointing.

NEC does provide an excellent three-year warranty with its system, and one year of on-site service is included as well.—CV

NETIS Technology Inc.

NETIS Pentium N566VL

The 66-MHz NETIS Pentium N566VL presents an admirable mix of high performance and low price (\$3,799).

Packaged in an all-metal desktop case, the N566VL offered an uncluttered interior layout, with three of five 16-bit ISA expansion slots and one of three VL-Bus slots left open in our tested configuration. But after a double-speed CD-ROM drive, two floppy disk drives, and a hard disk were installed, only a single 5.25-inch internal drive bay was left open.

The Diamond Viper VLB video adapter with 2MB of video memory—and its Weitek Power 9000 video chip set—helped the system log an above-average Graphics WinMark score, but the N566VL's DOS video score was slightly below



FACT FILE

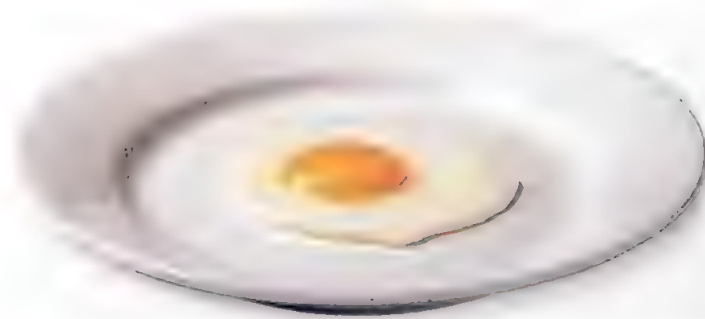
NETIS Pentium N566VL

List price (tested configuration): \$3,799. **Processor/Memory:** Pentium/66, 16MB RAM, 512K external cache. **Data storage:** Western Digital Cavar 2340 340MB IDE hard disk with 64K cache, Promise DC4030VL-2 VL-Bus-card disk controller with 2MB cache, Toshiba 3401B CD-ROM drive. **Display:** Diamond Viper VLB VL-Bus-card video controller with 2MB VRAM, View Magic CA-1565 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024. **Software:** DOS 6.0, Windows 3.1. **In short:** Strong performance under both DOS and Windows makes the \$3,799 NETIS Pentium N566VL a good value.

NETIS Technology Inc.; 800-577-7526, 408-263-0368.

472 On reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR



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► **S U M M A R Y O F F E A T U R E S**

CONTINUES

Products listed in alphabetical order	Int. Instr. Blue Max Monolith Business Partner P5	Mega Impact V-60PCI+	Micron P60PCI Powerstation	Mitsuba Professional Pentium	National MicroComputers NMC Expert System P60	NEC Image P60	NETiS Pentium N566VL	Novacor Novas
List price (tested configuration)	\$4,799	\$3,795	\$4,958	\$3,895	\$5,553	\$5,386 (estimated)	\$3,799	\$4,201
Processor interface and speed	Pentium/60	Pentium/60	Pentium/60	Pentium/60	Pentium/60	Pentium/60	Pentium/66	Pentium/60
Hard disk capacity and interface	528MB IDE	342MB IDE	528MB IDE	342MB IDE	545MB Fast SCSI-2	540MB IDE	340MB IDE	342MB IDE
Dealers/Direct-distribution channel	■ ■	■ ■	■ ■	■ □	■ ■	■ ■	□ ■	■ ■
Case style	Tower	Mini-tower	Desktop	Tower	Desktop	Desktop	Desktop	Desktop
Power supply (and number of connectors)	250W (6)	200W (6)	230W (6)	300W (11)	200W (5)	165W (3)	230W (6)	230W (7)
DOS and Microsoft Windows included	■	■	■	■	■	■	■	■
Warranty	1 year	1 year	1 year	2 years	1 year parts, 2 years labor	3 years	1 year	1 year
On-site service charge	Included (1 year)	N/A	Included (1 year)	\$35 (1 year)	\$39 (1 year)	Included (1 year)	\$150 (1 year)	N/A
Processor and Memory								
Bus architecture (primary, secondary)	ISA, VL-Bus	ISA, PCI	ISA, PCI	ISA, VL-Bus	ISA, VL-Bus	EISA, PCI	ISA, VL-Bus	ISA, VL-Bus
Motherboard manufacturer	International Instrumentation	Intel	Micronics	Mitsuba	ECS	NEC	TMC	American Digicom
Chip set manufacturer	OPTi	Intel	Intel	OPTi	OPTi	Intel	OPTi	OPTi
Processor upgrade path	Standard	ZIF	ZIF	Standard	Standard	ZIF	Standard	Standard
BIOS version (or date)	AMI (10/19/93)	AMI (11/30/93)	Phoenix (9/16/93)	AMI (11/11/92)	AMI (11/4/93)	Phoenix (11/12/93)	AMI (11/11/92)	AMI (10/12/93)
Flash memory/16550 UART support	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	□ □	□ □
Installable system RAM	8MB-128MB	8MB-128MB	8MB-128MB	8MB-128MB	8MB-128MB	8MB-192MB	4MB-128MB	2MB-128MB
External RAM cache	64K-2MB	0-256K	0-256K	512K-1MB	256K-1MB	256K	128K-512K	64K-512K
Cache architecture	Two-way set-associative	Direct-mapped	Four-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-back	Write-back	Write-through	Write-back	Write-back
Components								
Available hard disk sizes	170MB-2.4GB	343MB-2.1GB	245MB-2GB	200MB-2GB	540MB-2.1GB	250MB-540MB	254MB-1GB	340MB-1.2GB
Disk controller interface, location	VL-Bus, card	PCI, card	PCI, card	VL-Bus, card	VL-Bus, card	PCI, motherboard	VL-Bus, card	VL-Bus, card
Accessible drive bays (5.25", 3.5")	4, 0	2, 2	3, 0	5, 2	3, 0	2, 0	3, 1	3, 1
Internal drive bays (5.25", 3.5")	2, 0	0, 1	0, 2	0, 3	0, 2	0, 2	0, 1	0, 1
Floppy disk drives	1.44MB	1.2MB, 1.44MB	Dual 1.2MB/1.44MB	Dual 1.2MB/1.44MB	Dual 1.2MB/1.44MB	1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
CD-ROM drive	Toshiba 3401B	Toshiba 3401B	Mitsumi FX1001D	Mitsumi CRMC	Toshiba 3401B	NEC MultiSpin 3Xi	Toshiba 3401B	Sony CDU31A-03
ISA, EISA, MCA slots	5, 0, 0	5, 0, 0	5, 0, 0	4, 0, 0	5, 0, 0	0, 3, 0	5, 0, 0	5, 0, 0
VL-Bus, PCI, proprietary local-bus slots	3, 0, 0	0, 3, 0	0, 3, 0	2, 0, 0	2, 0, 0	0, 2, 1	3, 0, 0	2, 0, 0
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 1, 1	1, 2, 0	1, 3, 0
Display circuitry interface, location	VL-Bus, card	PCI, card	PCI, card	VL-Bus, card	VL-Bus, card	PCI, card	VL-Bus, card	VL-Bus, card
Video chip set manufacturer	Weitek	S3	Weitek	Tseng	Tseng	Weitek	Weitek	Tseng
Video RAM	2MB	1MB	2MB	1MB	2MB	2MB	2MB	2MB

N/A—Not applicable: The product does not have this feature.

ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., ECS—Elitegroup Computer Systems Inc., SIC—SIC Research, SVC—Silicon Valley Computer, TMC—TMC Research.

average. The system's 340MB Western Digital IDE hard disk and Promise Technology VL-Bus disk controller card with 2MB of cache let the unit garner an above-average DOS disk score, but the machine fell back into the average range on our Disk WinMark tests.

The power of this machine's 66-MHz Pentium CPU was evident on our processor tests, where the N566VL ended up on a par with its 66-MHz counterparts. The system's Winstone and DOSmark scores were its strong points—an indication that the system has been fully optimized toward real-world applications.

With its combined low price and reasonable performance, the NETiS Pentium N566VL presents itself as a good choice for both DOS and Windows users.—RA

Novacor Inc.

Novacor Novas

At \$4,201, the 60-MHz Novacor Novas fell into the middle of the roundup in terms of price; except for the system's brilliant showing on our DOS-based video tests, it didn't manage to stand out.

In our tested configuration, this unit's solid desktop case offered four available 16-bit ISA slots and one open external drive bay. The machine's two VL-Bus slots were occupied by a Cardex Cobra video adapter and a combination disk and I/O controller board. A single 8-bit ISA slot was occupied by a SCSI controller for the Sony double-speed CD-ROM drive. The Novas came with a pair of AC-powered speakers, which could be plugged into the headphone jack of the CD-ROM drive. The included CDPLAY software utility lets the system play audio CDs without a sound card.

As far as performance goes, the Novas turned in the lowest processor score of this roundup. Though it also posted one of the lowest Winstone scores, the system did redeem itself with an above-average DOSmark score. Thanks to its Cardex Cobra video adapter, with 2MB of video memory and a Tseng video chip set, the Novas rose well above the test pack on our DOS video tests, though its Graphics WinMark score fell below average for this



► FACT FILE

Novacor Novas

List price (tested configuration): \$4,201.

Processor/Memory: Pentium/60, 16MB RAM, 512K external cache **Data storage:** Conner CP30344 342MB IDE hard disk with 512K cache, Promise TP-2030VL VL-Bus-card disk controller with 4MB cache, Sony 31A-03 CD-ROM drive **Display:** Cardex Cobra VL-Bus-card video controller with 2MB DRAM, Arche 215 AX 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.0, Windows 3.1 **In short:** If you prefer to

work in DOS, this reasonably priced Pentium PC may be the machine for you

Novacor Inc., 800-486-6682, 408-441-6500

473 On reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **POOR**

group. With a 342MB Conner hard disk and Promise Technologies VL-Bus IDE controller with 4MB of cache, the system turned in a below-average score on our Disk WinMark tests but managed nearly an average one on our DOS disk tests.—RA

Polywell Computers Inc.

Poly 586DX-60PI

With its extra-tall tower case, the \$4,800 Poly 586DX-60PI from Polywell Computers looks impressive, but its performance proved it to be an average player in the 60-MHz Pentium PC arena.

Between its tall case (almost 27 inches

high) and its 300-watt power supply, this system offers plenty of room for internal expansion and ample power for additional expansion cards and devices. Even with the 1.44MB and 1.2MB floppy disk drives



► FACT FILE

Poly 586DX-60PI

List price (tested configuration): \$4,800.

Processor/Memory: Pentium/60, 16MB RAM, 256K external cache **Data storage:** Seagate ST11200N 1GB Fast SCSI-2 hard disk with 256K cache, Asus PCI-SC200 PCI local-bus-card disk controller, Texel DM-3028 CD-ROM drive **Display:** Diamond Viper PCI local-bus-card video controller with 2MB VRAM, ADI MicroScan 4G 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Windows 3.1 **In short:** The roomy high-tower Poly 586DX-60PI posted midlevel performance scores, but its tower case has room for expansion.

Polywell Computers Inc., 800-999-1278, 415-583-7222

474 On reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **GOOD**

installed, along with the 1GB Seagate Fast SCSI-2 hard disk and double-speed CD-ROM drive, there were still three empty external drive bays and three empty internal bays—including one on the floor of the interior. Three of the five 16-bit ISA expansion slots were free in our tested configuration, as were two of the three PCI local-bus slots.

The system's benchmark test scores were not as lofty. With its Diamond Viper PCI video board carrying a Weitek chip set and 2MB of video RAM, the unit managed only a below-average score on our DOS-based video tests; but it posted the fifth-best score in this roundup on our Graphics WinMark tests. On the other hand, the Poly achieved below-average DOS disk and Disk WinMark scores using a Seagate hard disk and PCI-based Asus Fast SCSI-2 controller. On our Winstone test, the Poly's score was below average when compared with that of

other 60-MHz entries.

The Poly's spacious design and large hard disk capacity, however, allow users plenty of space for additional hardware and software.—RA

Silicon Valley Computer Inc.

Silicon Valley Pylon 1 586

The \$3,495 Silicon Valley Pylon 1 586 offers solid all-around performance and some attractive supporting features at a very reasonable price.

The roomy and accessible tower for this 66-MHz Pentium system provides considerable opportunity for expansion. The unit has five ISA slots; three VESA local-bus slots that may, alternatively, be used as additional ISA slots; four SIMM banks for upgrading RAM to 128MB; four accessible drive bays; and four internal drive bays. The TMC-made motherboard sports a VL-Bus controller for the floppy disk drives and hard disk.

The ample 540MB Connor IDE hard disk, configured with 256K of cache, helped the system turn in scores that were



► FACT FILE

Silicon Valley Pylon 1 586

List price: \$3,495. **Processor/Memory:** Pentium/66, 16MB RAM, 256K external cache **Data storage:** Conner CP30544 528MB IDE hard disk with 64K cache, Silicon Valley ADP90VL VL-Bus-card disk controller, Panasonic CR-562B CD-ROM drive **Display:** Diamond Viper VLB video controller with 2MB VRAM, KFC GBVCA-15 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Windows 3.1, Microsoft Works, Microsoft Publisher, Microsoft Money, AntiVirus for Windows **In short:** The Silicon Valley Pylon 1 586 offers

solid performance at a reasonable price

Silicon Valley Computer Inc., 800-600-8111, 415-967-1100

475 On reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **EXCELLENT**

Expandability **GOOD**

► **S U M M A R Y O F F E A T U R E S**

ENDS

PC MAGAZINE
EDITOR'S CHOICE

Products listed in alphabetical order

■ = YES □ = NO

	Poly 586DX-60P1	Silicon Valley Pylon1 586	Tangent P560	Tri-Star P5 PCI-Station	Unitek P60LB	Zenon Z-Optimus PCI Pentium 60MHz	ZEOS Pantora-66
List price (tested configuration)	\$4,800	\$3,495	\$3,895	\$6,395	\$3,395	\$2,999	\$3,895
Processor type and speed	Pentium/60	Pentium/66	Pentium/60	Pentium/60	Pentium/60	Pentium/60	Pentium/66
Hard disk capacity and interface	1GB Fast SCSI-2	528MB IDE	344MB Fast SCSI-2	540MB IDE	425MB IDE	546MB Fast SCSI-2	540MB IDE
Dealers/Direct-distribution channel	■ ■	■ ■	□ ■	■ ■	□ ■	□ ■	■ ■
Case style	Tower	Tower	Desktop	Tower	Tower	Tower	Tower
Power supply (and number of connectors)	300W (6)	250W (6)	250W (5)	250W (9)	300W (6)	250W (8)	200W (10)
DOS and Microsoft Windows included	■	■	■	■	■	■	■
Warranty	2 years parts, 5 years labor	3 years	1 year	2 years parts, lifetime labor	1 year parts, lifetime labor	3 years parts, lifetime labor	1 year
On-site service charge	\$75 (1 year)	\$79 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$50 (1 year)	\$49 (1 year)
Processor and Memory							
Bus architecture (primary, secondary)	ISA, PCI	ISA, VL-Bus	ISA, PCI	ISA, PCI	ISA, VL-Bus	ISA, PCI	ISA, PCI
Motherboard manufacturer	Asus	TMC/SVC	American Digicom/Intel	Intel	Tyan	Asus	ZEOS
Chip set manufacturer	Intel	OPTI	Intel	Intel	OPTI	Intel (Mercury)	Intel
Processor upgrade path	Standard	Standard	ZIF	ZIF	Standard	Standard	ZIF
BIOS version (or date)	Award (1/1/93)	AMI (11/11/92)	AMI (9/24/93)	AMI (11/11/93)	AMI (11/11/92)	Award (1/1/93)	Phoenix (12/15/93)
Flash memory/16550 UART support	■ ■	□ □	■ ■	■ ■	■ ■	■ □	■ ■
Installable system RAM	8MB-192MB	2MB-128MB	4MB-128MB	8MB-128MB	8MB-128MB	4MB-192MB	4MB-192MB
External RAM cache	256K-512K	256K-512K	256K-1MB	0-256K	256K-512K	128K-512K	256K-512K
Cache architecture	Direct-mapped	Two-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Four-way set-associative	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-through	Write-back	Write-through	Write-back
Components							
Available hard disk sizes	340MB-4GB	210MB-6.4GB	260MB-1GB	540MB-2.1GB	340MB-2GB	250MB-1GB	107MB-2GB
Disk controller interface, location	PCI, card	VL-Bus, card	PCI, card	PCI, card	VL-Bus, card	PCI, card	PCI, motherboard
Accessible drive bays (5.25", 3.5")	6, 0	4, 0	3, 0	4, 0	3, 2	5, 2	4, 0
Internal drive bays (5.25", 3.5")	4, 0	2, 2	0, 2	2, 2	1, 2	1, 3	2, 4
Floppy disk drives	1.2MB, 1.44MB	1.44MB	1.44MB	Dual 1.2MB/1.44MB	1.44MB	1.44MB	1.44MB
CD-ROM drive	Plextor DM-302B	Panasonic CR562B	None	Plextor DM-302B	Sony CDU-33A	Toshiba 3401B	Mitsumi CRM CFXD01D
ISA, EISA, MCA slots	5, 0, 0	5, 0, 0	5, 0, 0	5, 0, 0	5, 0, 0	5, 0, 0	5, 0, 0
VL-Bus, PCI, proprietary local-bus slots	0, 3, 0	3, 0, 0	0, 3, 0	0, 3, 0	2, 0, 0	0, 3, 0	0, 3, 0
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 3, 0	1, 2, 0	1, 2, 0
Display circuitry interface, location	PCI, card	VL-Bus, card	PCI, card	PCI, card	VL-Bus, card	PCI, card	PCI, card
Video chip set manufacturer	Weitek	Weitek	Weitek	Matrox	Weitek	Matrox	Weitek
Video RAM	2MB	2MB	2MB	4MB	2MB	2MB	2MB

ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., ECS—Elitegroup Computer Systems Inc., SIC—SIC Research, SVC—Silicon Valley Computer, TMC—TMC Research

slightly above average under both DOS and Windows. The Diamond Viper VLB video card with a Weitek Power 9000 chip set and 2MB of video RAM helped the system attain upper-tier Graphics WinMark and Winstone scores. The unit's DOS video and disk scores were respectable—and generally comparable with those of similarly priced and configured systems. While the Pylon 1's DOSmark score was only average, its Winstone score was above average.

Add points to this Silicon Valley system for its complete and easy-to-read documentation (includes a manual for the

motherboard whose index covers everything from B to T), MS-DOS 6.2, and a generous three-year parts-and-labor warranty. On-site service is reasonably priced at \$79 for one year.—*Melissa J. Perenson*

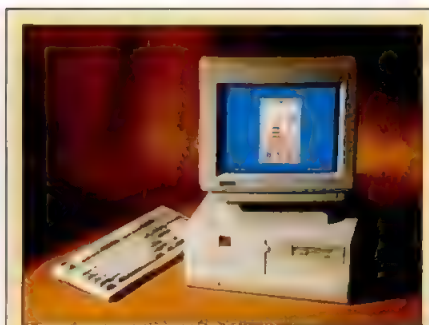
Tangent Computer Inc.

Tangent P560

The \$3,895 Tangent P560 from Tangent Computer is a well-rounded machine that combines good performance with an attractive price.

The P560 came with an American

Digicom/Intel motherboard, a 60-MHz Pentium processor and an integrated controller for the floppy disk drive, additional hard disk, and PCI local-bus. To boost performance, Tangent connected the 344MB SCSI Seagate hard disk via a SCSI/PCI controller; accordingly, this system's DOS disk score was higher than that of the Austin Premier P5-60 Desktop—a system that featured the same motherboard, but with an integrated hard disk controller. The P560's Diamond Viper PCI video card with the Weitek Power 9000 chip set and 2MB of video RAM allowed the machine to turn in a



► FACT FILE

Tangent P560

List price: \$3,895 **Processor/Memory:** Pentium/60, 16MB RAM, 256K external cache **Data storage:** Seagate ST3390N 344MB SCSI-2 hard disk with 256K cache, NexStor NXT-93 PCI local-bus-card disk controller **Display:** Diamond Viper PCI local-bus-card video controller with 2MB VRAM, CTX CTX-1560 15-inch monitor with a 70-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.0, Windows 3.1 **In short:** The Tangent P560 is a middle-of-the-pack machine that is capable of good performance; this machine has the added bonus of SCSI and plenty of room for expansion.

Tangent Computer Inc.;
800-800-5550, 415-342-9388.

476 On reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **GOOD**

particularly strong Graphics WinMark score.

The system provides sufficient room for expansion, with three accessible drive bays, two internal drive bays, five 16-bit ISA slots, three PCI slots, a SCSI PCI controller, and a ZIF socket for processor upgrades. The accessible and organized desktop interior lends itself to upgradability.

This system did fall short, however, on a few details: It did not include a CD-ROM drive (A Sony CDU-33A costs an extra \$200), and a manual for the motherboard did not come with the system we tested.—MJP

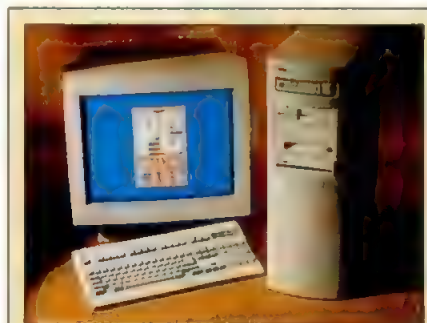
Tri-Star Computer Corp.

Tri-Star P5 PCI-Station

At \$6,395, the Tri-Star P5 PCI-Station comes with one of the higher prices in this roundup, but high-powered CAD and Windows users may find its performance and components worth the cost.

The 60-MHz Pentium tower system does deliver a lot for the money. Our test unit was packed with 32MB of RAM,

256K of external cache, two Western Digital 540MB hard disks in slide-out drawers, a dual floppy disk drive, and a double speed CD-ROM drive. There were also one 5.25-inch and two 3.5-inch internal drive bays free. The system came



► FACT FILE

Tri-Star P5 PCI-Station

List price: \$6,395 **Processor/Memory:** Pentium/60, 32MB RAM, 256K external cache **Data Storage:** Western Digital Caviar 2540 540MB IDE hard disk with 128K cache, integrated PCI local-bus-card disk controller, Plextor 3028 CD-ROM drive **Display:** Matrox MGA-II PCI local-bus-card video controller with 4MB VRAM, Nanao F760W 21-inch monitor with a 72-Hz refresh rate at 1,280-by-1,024

Software: DOS 6.2, Windows 3.1 **In short:** While the Tri-Star P5 PCI-Station captured the number-one position on our Graphics WinMark benchmark tests, its performance under DOS lagged.

Tri-Star Computer Corp.; 800-800-7668, 602-961-3401.

477 On reader service card

SUITABILITY TO TASK

DOS applications **FAIR**

Windows applications **EXCELLENT**

Expandability **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **AVERAGE**

Repair service **AVERAGE**

Technical support **AVERAGE**

with an optional 21-inch Nanao monitor (\$300 option), though the machine's standard—the new ViewSonic 21-inch monitor—will certainly suffice.

Performance was nothing to sneeze at either—at least in the Windows arena. Disk performance for the PCI-Station was about average under both DOS and Windows, but the PCI-Station really excelled in terms of Windows video. This machine's Matrox PCI video card, loaded with 4MB of VRAM, helped it to take first place on our Graphic WinMark tests and a top-ten position on our Winstone test. Since this video card is optimized for Windows, however, it contributed to the PCI-Station achieving one of the worst DOS video and DOSmark scores in the roundup.

Tri-Star's warranty is slightly better than average: two years for replacement parts, a lifetime for labor, and one year of free on-site service.—Anush Yeghazarian

Unitek Technology Inc.

Unitek P60LB

The VL-Bus—based Unitek P60LB costs \$3,365 and offers decent though unremarkable performance when compared with the other systems in this group.

The P60LB's forte is expansion. Of the five accessible bays, only two are filled, and though the 425MB Western Digital hard disk occupies one 3.5-inch bay, there are still two additional internal bays available. Both VESA slots are filled—one with the video controller and the other with the hard disk controller—and since the I/O ports are not integrated on the motherboard, one of the four ISA slots is taken as well. The one ISA 8-bit slot is used by the CD-ROM controller, and all four SIMM sockets were filled to provide 16MB of RAM in our test unit.

This system isn't a screamer, but it



► FACT FILE

Unitek P60LB

List price (tested configuration): \$3,365 **Processor/Memory:** Pentium/60, 16MB RAM, 512K external cache **Data storage:** Western Digital Caviar 2420 425MB IDE hard disk with 128K cache, Promise DC-4030VL VL-Bus—card disk controller with 2MB cache, Sony CDU-33A CD-ROM drive **Display:** Diamond Viper VLB video controller with 2MB VRAM, ViewSonic 15 1564 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1.

In short: Even though the Unitek P60LB's benchmark test scores are not spectacular, its price of \$3,365 is hard to beat.

Unitek Technology Inc.;
800-944-5650, 909-930-5700

478 On reader service card

SUITABILITY TO TASK

DOS applications **GOOD**

Windows applications **GOOD**

Expandability **GOOD**



3



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to the things you
advanced communications
have to do:
capabilities, a continent
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away. The artistry of its new,
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tablet. Above all, its modular
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design lets it expand for
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should provide adequate performance. The P60LB's overall performance was brought down by one of the lowest processor scores of the group, although its 60-MHz Pentium was bolstered by the presence of 512K of external cache. The Weitek Power 9000 chip and 2MB of RAM on the unit's Diamond Viper VLB video card should have helped it achieve solid video performance under Windows, but the P60LB managed only below average Graphics WinMark and Winstone scores. With its 425MB Western Digital IDE hard disk with the Promise DC-4030VL disk controller, this machine turned in below-average disk scores under both DOS and Windows.

On the whole, there are worse—and better—systems in this roundup, but few carry a more attractive price tag.—AY

Zenon Computer System Inc.

Zenon Z-Optimus PCI Pentium 60MHz

For \$2,999, the Zenon Z-Optimus PCI Pentium 60MHz, from Zenon Computer System, offers good though inconsistent performance and a better-than-average warranty.

This tower system has plenty of room for expansion. Only 3 of its 11 drive bays are filled—one 5.25-inch bay with a double-speed CD-ROM, two of the 3.5-inch bays with a 546MB Maxtor Fast SCSI-2 hard disk and a 1.44MB floppy disk drive. Two of the unit's three PCI slots are used for the video and hard disk controllers, but five ISA slots remain, one of which is used by the I/O card. Of six SIMM sockets, four were filled, thus giving our test system 16MB of RAM.

Overall performance was adequate, but the Z-Optimus excelled in Windows tasks, as evidenced by its third-place Winstone score. The unit's solid performance in this area was due largely to its Matrox video controller carrying 2MB of video RAM, with which it garnered the second-highest Graphics WinMark score in the roundup. Like other machines using the Matrox video controller, the Z-Optimus turned in a very low DOS video score, which pulled its DOSmark score to well below the average. The system's Maxtor Fast SCSI-2 hard



► FACT FILE

Zenon Z-Optimus PCI Pentium 60MHz

List price (tested configuration): \$2,999

Processor/Memory: Pentium/60, 16MB RAM, 256K external cache **Data storage:** Maxtor MXT-540S 546MB Fast SCSI-2 hard disk with 256K cache, Asus PCI-SC200 PCI local-bus-card disk controller, Toshiba 3401 CD-ROM drive.

Display: Matrox MGA PCI local-bus-card video controller with 2MB VRAM, MAG LX1564 15-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** A powerhouse under Windows, the Zenon Z-Optimus PCI Pentium 60MHz carries one of the lowest

prices in this lineup—\$2,999

Zenon Computer System Inc., 800-899-6119, 818-935-1828.

470 On reader service card

SUITABILITY TO TASK

DOS applications	FAIR
Windows applications	EXCELLENT
Expandability	GOOD

disk with the Asus PCI-SC200 controller did well under both DOS and Windows.

The warranty on the Z-Optimus is a bit better than most, with three years for parts and a lifetime for labor, but the first year of on-site service is an additional \$50.—AY

ZEOS International Ltd.

ZEOS Pantera-66

The \$3,895 ZEOS Pantera-66 combines quality features, good price, and high performance under both DOS and Windows. This unit is a value choice in this high-powered arena of Pentium machines.

The tower case used only three of its ten drive bays, leaving plenty of room for future add-ons. The unit had 16MB of RAM installed in four of its six SIMM sockets (total system memory is expandable to 192MB) and used only one of its three PCI slots, for the video controller. An ISA slot was taken as well—with the CD-ROM controller—but all other controllers, including a Fast SCSI-2 controller, were integrated on the motherboard.

In terms of performance, the Pantera-66 left little to be desired. Though not the top scorer in every category, this machine scored high consistently and laid claim to no low scores whatsoever. The good processor score should come as no surprise, since the Pantera-66 has one of the six 66-MHz Pentiums in this roundup, but this system, which used a 540MB Western Digital Caviar IDE drive and integrated PCI controller, also impressed us with its number-one Disk WinMark score and its above-average DOS disk score. Though the Diamond Viper PCI video card has 2MB of video RAM and the Weitek Power 9000 chip—traditionally a good performer only



► FACT FILE

ZEOS Pantera-66

List price (tested configuration): \$3,895.

Processor/Memory: Pentium/66, 16MB RAM, 256K external cache **Data storage:** Western Digital Caviar 2540 540MB IDE hard disk with 256K cache, integrated PCI local-bus-card disk controller,

Mitsumi CRMCFX001D CD-ROM drive **Display:** Diamond Viper PCI local-bus-card video controller with 2MB VRAM, Zeos CMS-1561 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows for Workgroups 3.11, choice of one application.

In short: Solid performance and affordable price make the ZEOS Pantera-66 a quality investment.

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Technical support	BELOW AVERAGE

under Windows—this unit managed to get both a high Graphics WinMark score and a respectable DOS video score. The system also combined an above-average DOSmark score and the fourth-highest Winstone score, presenting itself as an excellent Pentium PC choice.—AY□

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Saves you money: no need to buy various utilities to improve Windows performance.



Chicago: *Under* Construction

A look behind the scaffolding shows that Chicago is the biggest redesign of Windows since Windows itself.

*By Jeff Prorise
& Michael J. Miller*

Operating systems are always playing catch-up with hardware. When Intel's 80386 microprocessor was first introduced, vendors began scurrying to create next-generation operating systems that would exploit the power of this substantially different, 32-bit chip. Users began salivating at the thought of running 32-bit applications in a true multitasking, protected environment.

The notion of a new operating system held tremendous promise: 32-bit applications would be faster and more powerful. New graphical user interfaces would make computing a more human experience. Multitasking would let multiple applications run simultaneously while reducing the wait times we'd all grown accustomed to. New protected-mode architectures would prevent one



Chicago

misbehaving application from crashing an entire system.

TIME TO PERCOLATE

But great notions take time to percolate. Seven years later most PC users are leaving their 386s behind, but they're still waiting for their advanced OS. True 32-bit multitasking systems are common on the Macintosh and on workstations running Unix. And yes, many of us have tried advanced 32-bit operating systems such as IBM's OS/2 2.x or Microsoft Windows NT. Those who have made the move to OS/2, Windows NT, or Unix, however, must make do with a relatively short list of native full 32-bit applications—and suffer from some debilitating hardware compatibility issues. For now, most PC users take a more secure route by continuing to use DOS and Microsoft Windows 3.1.

Whether it's the great notion we've been waiting for or not, Microsoft's Chicago project will change the landscape. Scheduled to be the next major upgrade for Windows—some call it Windows 4.0—Chicago, once and for all, removes Windows from the limitations of DOS. With Chicago, Windows will become a bootable 32-bit operating system, offering such features as memory protection, multitasking, and multithreading (the ability of an application to manage multiple independent tasks simultaneously). As such, it's following in the footsteps of other systems such as OS/2 and Windows NT.

Chicago will introduce a variety of other novelties. It has a new desktop user interface that will combine the now-scattered File Manager, Program Manager, and Control Panel into one sensible, better-integrated environment. Building on features introduced in Microsoft Windows for Workgroups, Chicago will make networking an integral part of the operating system. It also offers built-in support for Plug and Play, designed to make installing and upgrading boards

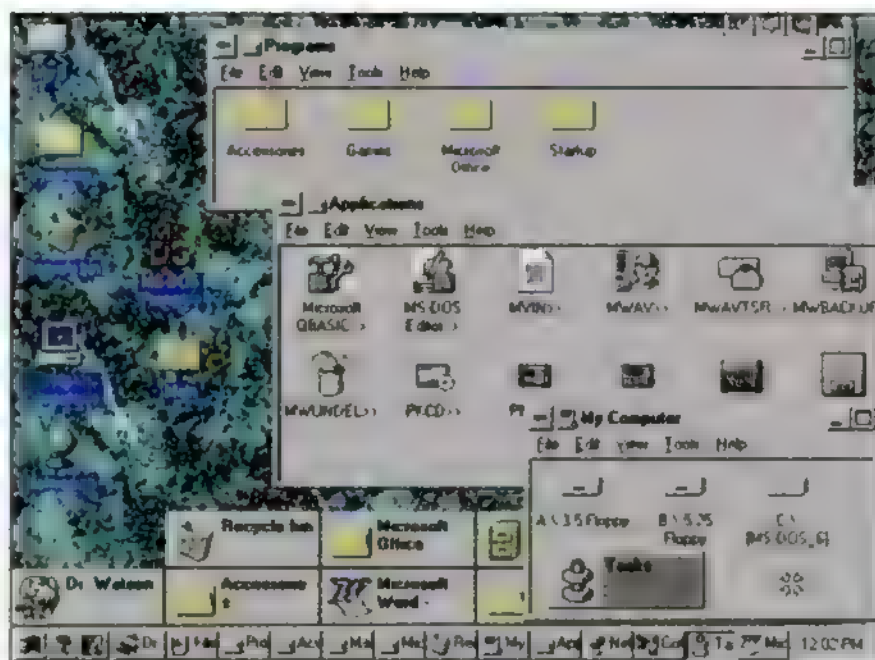
and peripherals much easier by eliminating the DIP-switch settings for interrupts and memory addresses that most PC users have grown to hate. It also supports a version of the Win32 application programming interface (API), making it compatible with most Windows NT applications.

But what really makes Chicago the favorite in the next-generation OS race is the huge popularity of Windows today. Microsoft will capitalize on this by positioning Chicago as the natural upgrade for Windows users. In fact, Microsoft says that Chicago will be completely compatible with today's Windows and DOS applications and device drivers, running them in a separate "virtual machine." In response to questions about performance,

principal APIs used by developers creating new Chicago applications.

We'll see how Win32 features vary between Chicago and NT, and how a subset of these features, Win32s, can be used by applications running under Windows 3.1. From there, we'll close in on Chicago's networking and e-mail features, and on its Plug and Play support, important both for upgrading desktops and for better integrating laptops with desktops.

We'll start by focusing particularly on the part of Chicago that is currently furthest from completion: the new user interface. In early test versions of Chicago, Microsoft has been experimenting with many subtle and not-so-subtle variations in the new UI; as of this writing, it's still not final, although we can give you the basic concepts.



The Chicago interface is far from final, but many basic paradigms are already in place.

Microsoft says that, using a 4MB machine as a standard platform, Chicago and Windows 3.1 will run the same set of Windows applications at the same speed. These are lofty notions, and the verdict won't be in until we test the shipping product. In the meantime, Chicago is still under construction and questions about speed, compatibility, and hardware requirements can't be fully answered.

ENTIRELY NEW

What we can tell you is that Chicago is an operating system with an entirely new architecture. In the next few pages, we'll take a good hard look at Chicago's underlying technology, and compare it with other PC operating systems. We'll begin with a walk through the basic architecture, and from there we'll look at Win32 and Microsoft OLE 2.0, the

OTHER GAMES

Chicago, of course, is far from being the only game in town. IBM's OS/2 2.1 already offers users a 32-bit multitasking, multithreaded operating system with surprisingly good Windows support, and IBM is currently planning OS/2's future. One major step will be the inclusion of new object-oriented application frameworks from Taligent, the Apple/IBM joint venture. IBM is also working on a new technology called

Workplace OS, designed to make OS/2 faster and more portable. Taligent itself is planning a full new operating system, which will be object-oriented from the ground up.

Of course, Microsoft has its own higher-end offering, Windows NT, which is poised for a relatively minor upgrade in the near future. The next major upgrade to Windows NT, known as Cairo, is expected sometime next year and is planned to include a new, fully object-oriented file system. Clearly, Windows NT will be Microsoft's next major stepping-stone, and the real competitor to Taligent and Workplace OS.

As developers place their bets, as users ponder what Chicago will mean to them, and as other OSs prepare for the counter-attack, taking an early look at Chicago is clearly a timely notion.

Our Contributors: MICHAEL J. MILLER is the editor-in-chief, FRANK J. DERFLER, JR., is the senior networking editor, and JEFF PROSISE is a contributing editor of *PC Magazine*. THOMAS MACE was the associate editor in charge of this story.

Under Construction: The Desktop

BY JEFF PROSISE



To the person booting up Chicago for the first time, the user interface will appear vastly different from the one featured in Microsoft Windows 3.1. Familiar faces such as Program Manager and File Manager will be gone, made obsolete by a whole new desktop metaphor that pushes documents, not applications, onto center stage.

At the time of this writing—early February, about one month after the M5 alpha release of Chicago to developers—some elements of the user interface are not yet implemented, and others are not yet in their final form. But what's there, combined with information dispensed at recent developers' conferences, is plenty to tell us where the Windows user interface is headed—and how strikingly different it will be.

These differences run deeper than the new 3-D look and the variety of new controls and enhanced common dialog boxes that developers can use in their applications. In designing the Chicago user interface, Microsoft set two goals for itself. The first goal was to increase usability while flattening the learning curve for new users. The second goal was to increase the emphasis on methods as opposed to applications, and to begin the transition to the object-oriented desktop that will reach fruition in Microsoft's Cairo project.

BIG STEP

Of course, Chicago is not the only graphical environment moving in these directions, nor is it the first. Object-oriented desktop paradigms have already been pioneered in HP NewWave, NeXTStep, and OS/2 Workplace Shell, for example. But object-oriented concepts are new to

the Windows environment and they represent a big step.

New users of Windows 3.1 need to clear a number of conceptual hurdles in order to become proficient. Some of the most basic tasks that experienced users take for granted—for example, switching from one application to another—can be real stumbling blocks. In user studies,

one scenario that Microsoft saw acted out time and again was out-of-memory errors caused by users who inadvertently launched several instances of the same application, not realizing that the other instances were still active.

As a result, Chicago will make it easier to identify and switch to active applications. When the M5 release of Chicago boots up, a system toolbar at the bottom of the screen lists all active programs. Clicking on a program name activates that instance. Getting to the toolbar is never a problem because it remains on the screen at all times unless it has been configured to do otherwise. While the details of the toolbar implementation will probably change, the concept of having a readily accessible system toolbar on hand to do your bidding probably will remain.

The system toolbar is more than just a glorified task list. System commands such as Exit Windows and Help, which were formerly dispersed among Program Manager and File Manager menus, are now accessed from pop-up menus in the system toolbar. Other pop-up menus list recently used programs and data files so they can be

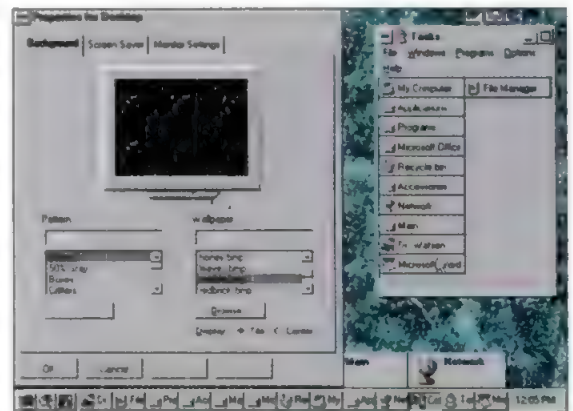
called up again quickly. They also list "personal" programs—programs that you like to keep just one mouse click away. In Windows 3.1, it is no less work to start a program that you use every day than one you use once a year. In Chicago, frequently-used programs will receive much-deserved precedence.

Another of the commands accessible through the system toolbar is Find, which pops up a search window that scans all or part of a disk for files matching criteria that the user specifies, including embedded words and phrases. This offers a solution to another common usability hurdle: keeping track of files.

Assuming all files will one day use Microsoft OLE 2.0's structured storage format (the basis for Cairo's file system), this search capability will eventually have the power to reveal all types of information contained within a file. It's reasonable to anticipate that the final version of Find will have powers to display many data files—especially those created by major application programs—in their native formats. Find's looks and features are still evolving, but it's clear that Chicago will have provisions for locating files regardless of their formats and physical locations.

OBJECT-ORIENTED DESKTOP

Chicago will bring to the Microsoft Windows environment a fundamentally

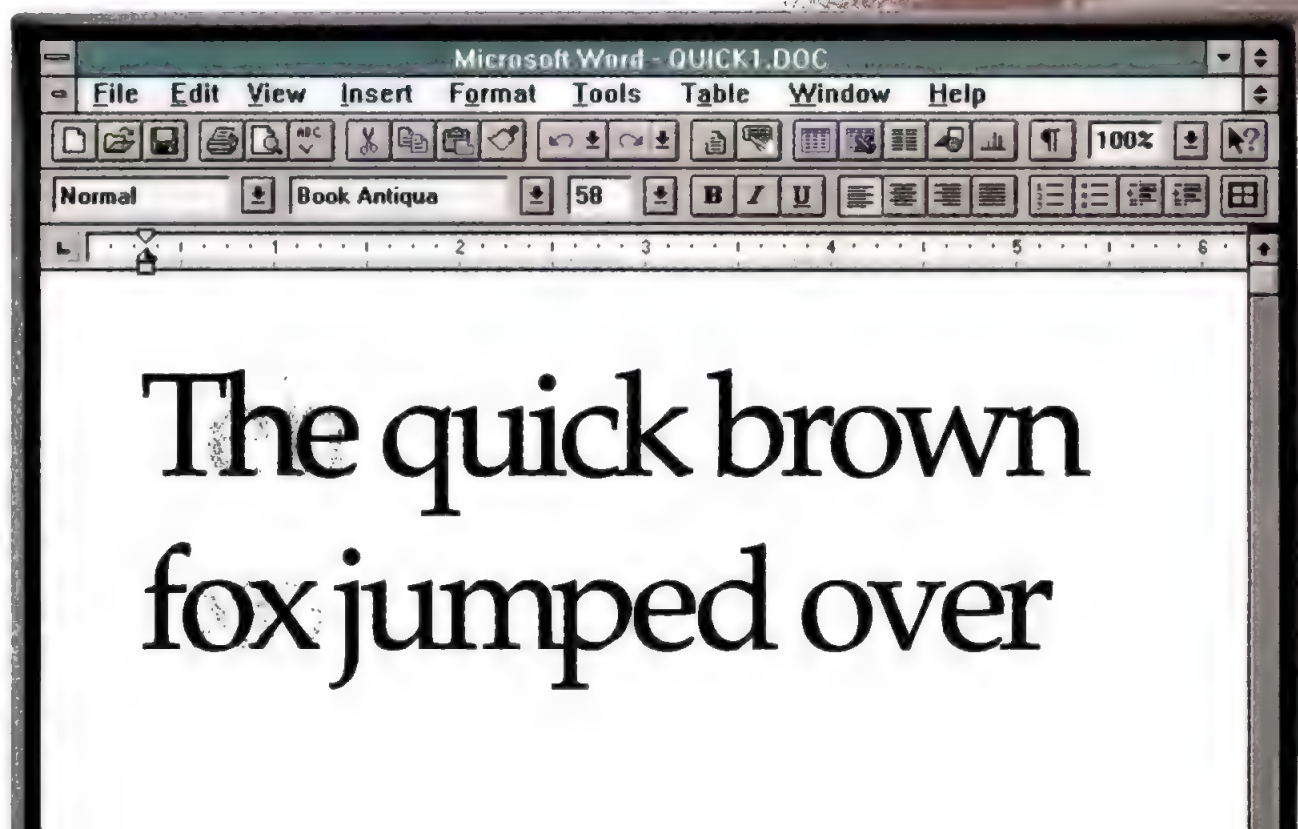


Right-clicking on an object, in this case the desktop, immediately brings up its associated property sheet.

new way of transferring thoughts into actions. Rather than thinking about sub-directories and files, you'll think about folders and objects. Objects are stored in folders, and may be operated upon using

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verbs (actions) such as Open, Copy, and Move. Objects may also be manipulated directly with actions such as clicking and dragging. If you want to edit a word processing document, you won't start a word processor and call up the document; you'll find the folder containing the document and tell the document to open. The word processor will get started, but only indirectly.

DEEPEN PARADIGM

Of course, you can do the same thing in Windows 3.1 by using file associations. But in Chicago, the paradigm runs much deeper. Consider, for example, how you go about changing the Program Information File (PIF) settings for a DOS program in Windows 3.1. First you start the PIF Editor, either from File Manager or Program Manager. Then you call up the PIF for the application, edit the settings, save the modified PIF back to disk, and close the PIF Editor.

In Chicago, the process is much simpler. Since the DOS program is an object (an application object), you simply click the right mouse button to pop up a menu listing the actions that can be performed on that object. Selecting Properties from the menu displays a series of tabbed property sheets whose contents look suspiciously like PIF settings. Make your changes to the property sheets and click on OK to save them. Next time the application object is invoked, it will automatically use the properties you just entered.

Notice what happened here. First, there is no longer a need for a PIF Editor to serve as a middleman between the application program and its properties. Once you understand that the right

mouse button always pops up an action menu, you can focus more on what you want to do and less on how to go about it. Second, the concept of opening and closing a PIF is completely abstracted. The PIF settings could be stored in a Windows 3.1-type PIF, or they could be stored in a binary registry somewhere out on a network. Knowledge of the storage mechanism neither impedes nor enhances the user's ability to manipulate the data.

This object-oriented view of the world finds applications throughout the Chicago shell. Everything is an object, including the background screen that serves as the Windows desktop. Right-clicking over the desktop and selecting Properties from the object menu displays property sheets specifying the screen resolution, the current wallpaper file, the active screen saver, and other characteristics of the desktop. It is no longer necessary to use Control Panel as an intermediary to make these choices.

OLE 2.0 is the glue that binds applications capable of acting upon objects to the objects displayed in the Chicago shell that they can act upon. Applications that support OLE can register document icons and verbs in the OLE database. The shell will use the icons registered in the database to represent documents created by those applications, and display the verbs in pop-up object menus. It will also support extensive drag-and-drop operations, with OLE providing the underlying mechanism.

It is abundantly clear at this point that OLE will play a major role in the Chicago shell. The shell will be highly extendable, and OLE will be the vehicle for extending it. Now more than ever, application devel-

opers should consider adding OLE 2.0 support to their programs (for more information concerning OLE and other issues that will affect application developers, see the section "Under Construction: Tools & Applications," later in this story).

And what of Program Manager and File Manager? They're gone, although the M5 build of Chicago creates a Programs folder from your old PROGRAM.MAN.INI and .GRP files just in case you insist on working the old way. Interestingly enough, the Programs folder responds to Windows 3.1-vintage setup programs that use DDE (Dynamic Data Exchange) to create program groups and program items inside Program Manager.

The concept of program items is basically passé, however. You no longer have to go through your system creating little icons for every application that you run. Instead, you can open the folder representing your computer's local storage system, which the shell creates and places on the desktop. This folder contains drive objects representing the local drives in your system. The drive objects behave like folders themselves, whose contents parallel the existing file and subdirectory structure. If you desire, frequently used folders and objects can be placed on the desktop for fast, convenient access. Unlike the Windows 3.1 desktop, which was little more than a backdrop for application windows, the Chicago desktop is an active part of the user environment.

The coming months are sure to bring additional changes to the look and feel of Chicago's user interface. But it's already certain to be vastly different from the one we use in Windows 3.1.

On the Desktop

We compare the user-interface features of today's mainstream Intel-platform operating systems with planned future directions.

Here Today

Microsoft Windows 3.1: Separate Program Manager and File Manager. No object-oriented features. Search capability by filename only.

OS/2 2.1: Object-oriented Workplace Shell with integrated program and file management. No object database or object tracking in basic product.

Microsoft Windows NT: Separate Program Manager and File Manager. No object orientation. No distributed object support.

Where We're Headed

Chicago*: Integrated management of programs and files on quasi-object-oriented desktop. Right mouse click brings up property list for objects. Has basic search capability by filename, file type, or text content, but VFAT file system is not object-oriented. DocFiles supported but not required.

Workplace OS for the PowerPC*: Choice of desktops includes Workplace Shell, will include Motif, System 7, and Windows 3.1.

Cairo*: Fully object-oriented. OLE DocFiles used as basis for fully searchable, object-oriented file system. Distributed object support.

* Preliminary feature set, based on prerelease information.

Under Construction: The Foundation

Although much of Chicago is in a state of flux at this early stage in the game, its base architecture is pretty well settled. In addition to being built around a 32-bit, preemptively scheduled, multitasking, multithreaded core, Chicago will also contain its own protected-mode file system. Both represent groundbreaking enhancements in the evolution of Windows; previous versions supported only limited forms of multitasking and borrowed their file systems from DOS.

Users moving to Chicago from Windows 3.x stand to realize a number of benefits as a result of the revamped architecture. Applications should run faster than ever before, in part because of their 32-bit nature. The system as a whole should be less prone to crashing and more responsive to input. Even 16-bit Windows 3.x applications may run faster because of the protected-mode file system.

CHICAGO ARCHITECTURE

The diagram "Chicago Architecture" presents Chicago as an operating system designer might see it. Two major components of the OS, the Virtual Machine Manager (VMM) and the file management subsystem, run at what is termed ring 0. This is the most privileged level of the four-ring Intel 386 protection model, giving these components unrestricted access to the rest of the system.

The VMM subsystem provides memory management, scheduling, and DOS Protected Mode Interface (DPMI) services to the system. Like the Windows 3.x VMM, it also includes all the Virtual Extended Drivers (VxDs) used to virtualize hardware devices. The file management subsystem encapsulates the various file systems that Chicago supports, the

BY JEFF PROSISE



block device drivers, and the Installable File System (IFS) manager.

Ring 3, the only other protection level used by Chicago, is the least privileged, best isolated level. The system Virtual Machine (system VM) runs here, and inside it are application programs and the core dynamic link libraries (DLLs)—KERNEL, USER, and GDI—that provide system services to them. These DLLs are placed in ring 3 to improve performance. If KERNEL, USER, and GDI ran in ring 0, every call an application made to a Windows API function would force a time-consuming ring transition, hampering performance. Native Chicago apps run in private address spaces inside the system VM; one application can't "see" the memory owned by another unless specific provisions have been made for shared memory. Win16 apps run in a shared address space within the system VM. As in Windows 3.x, DOS applications run in separate virtual machines.

Although Chicago is hyped as a "true 32-bit operating system," it still contains some 16-bit code. The 32-bit portions include most of KERNEL, about half of GDI (including the TrueType rasterizer, the print subsystem, and parts of the graphics engine), and only a fraction of USER. The portions that are not 32-bit are, of course, 16-bit, and were brought over

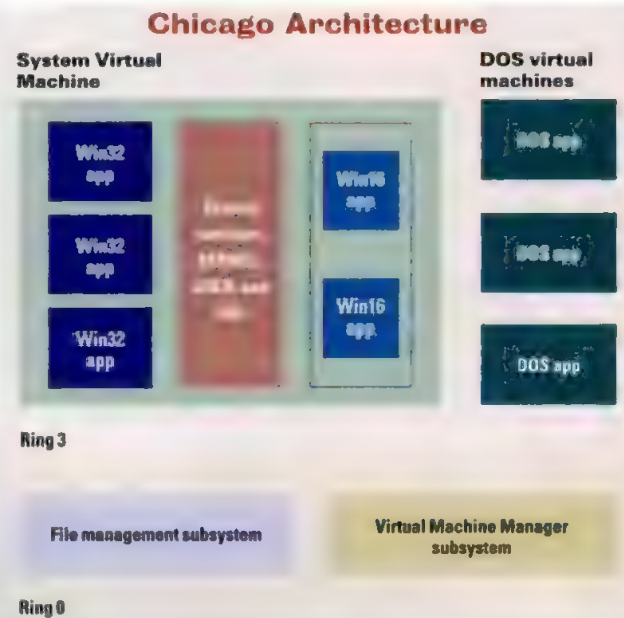
largely intact from Windows 3.1. This does not affect application programs, which still invokes system services using the Win32 API. Internally, however, KERNEL, USER, and GDI use something called thunking—automatic 16-bit to 32-bit conversions—to communicate between 16- and 32-bit domains.

Microsoft has gone to lengths to optimize the thunks and minimize their impact on performance. Critical portions of the kernel have also been rewritten in faster assembly language. One result of this fine-tuning is that Chicago's graphics subsystem promises to be faster than Windows NT's, which contains a minimum of assembly language in the interest of preserving cross-platform portability.

MULTITASKING, MULTITHREADING

Windows 3.x employs a mechanism known as cooperative multitasking to divide processor time among running Windows applications. The operating system never interrupts one task to allocate time to another; instead, it waits for the running application to yield control. This model has several undesirable traits, especially the fact that one ill-behaved application can freeze out other applications.

Chicago uses the more sophisticated preemptive multitasking model to allocate CPU time. Like Windows NT and OS/2 2.1, Chicago supports multiple concurrent threads of execution. Time is allocated on a per-thread basis. From the scheduler's



Architecture Overview

Here are the architectural highlights and where future developments are headed.

Here Today

Microsoft Windows 3.1: Nonbootable 16-bit environment running on top of DOS, for Intel-compatible platforms only. Uses cooperative multitasking. Native 16-bit programs share a virtual machine. Uses a 16-bit FAT file system. Does not support SMP. Supports DDE and OLE.

OS/2 2.1: Bootable, 32-bit, protected-mode operating system for Intel-compatible platforms. Uses preemptive multitasking and supports threads. Native 32-bit applications run in protected memory space. Uses a 32-bit file system. Does not support SMP. Supports DDE but not OLE.

Microsoft Windows NT: Bootable, 32-bit, protected-mode operating system for Intel-compatible, Alpha, and MIPS platforms (also planned for PowerPC). Uses preemptive multitasking and supports threads. Native 32-bit applications run in protected memory space. Uses a 32-bit file system. Supports SMP, DDE, and OLE.

Where We're Headed

Chicago®: Bootable, 32-bit, protected-mode operating system for Intel-compatible platforms only. Uses preemptive multitasking and supports threads. Native 32-bit applications run in protected memory space. Uses a 32-bit file system. Does not support SMP. Supports DDE and OLE.

Workplace OS for PowerPC (WPOS)®: 32-bit bootable, protected-mode operating system for PowerPC platforms (initially). Uses preemptive multitasking and supports threads. Native 32-bit applications run in protected memory space. Different interface "personalities" will run on top of WPOS. OS/2 will be the first, Windows 3.1, Macintosh, and System 7 are planned.

Cairo®: Bootable, 32-bit, protected-mode operating system for Intel-compatible, Alpha, MIPS, and PowerPC platforms. Uses preemptive multitasking and supports threads. Native 32-bit applications run in protected memory space. Uses a 32-bit file system. Supports SMP, DDE, and OLE.

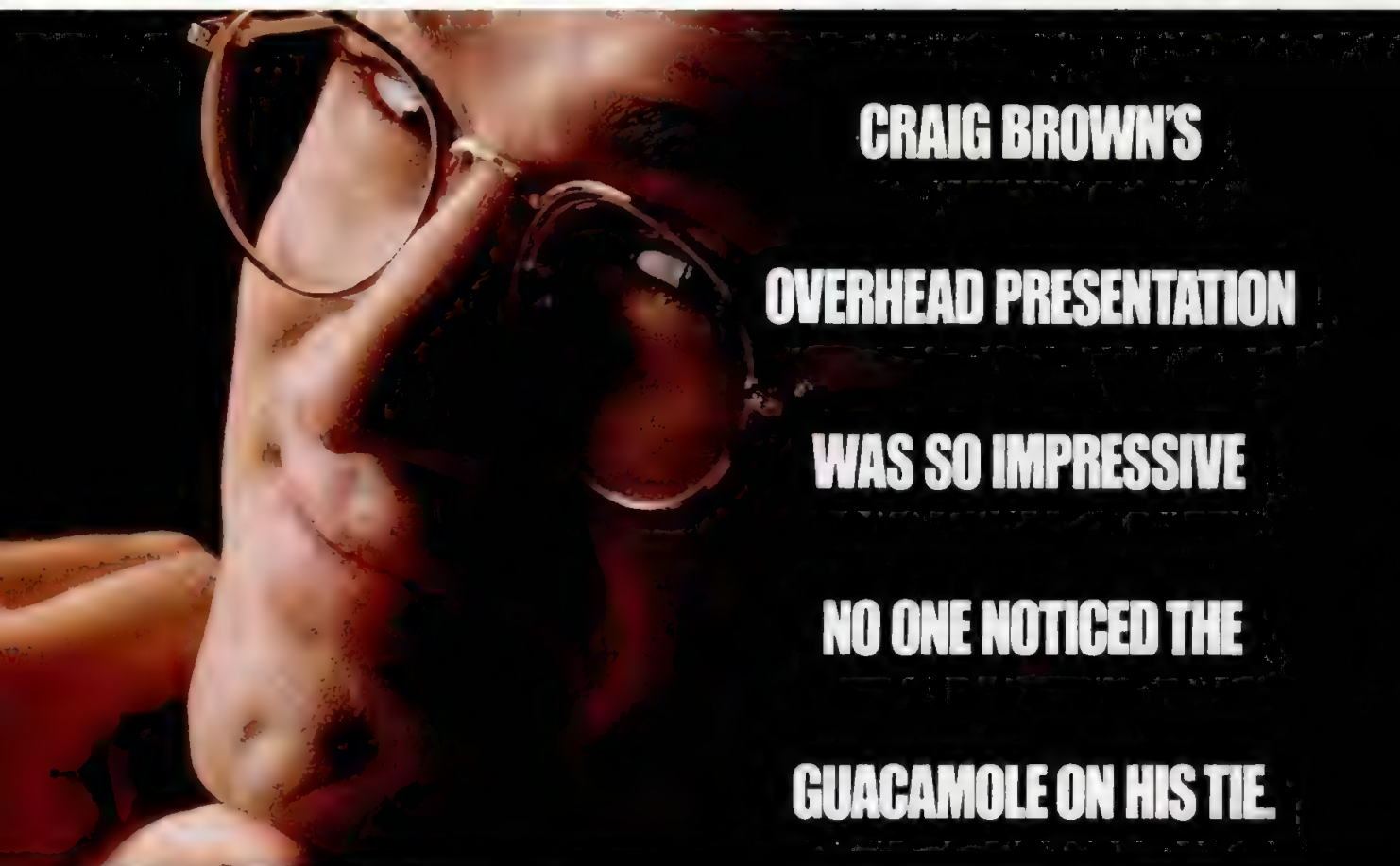
* Preliminary feature set, based on preliminary information.

point of view, the DOS VMs and the system VM address space shared by Win16 apps constitute one thread each. Each Win32 app running in the system VM represents at least one, and possibly two or more, threads. The scheduler allocates time among active threads based on execution priority, taking into account factors such as whether the thread belongs to a foreground or background process and how long it has

been since the thread was last run.

Win32 and DOS apps are preemptively multitasked. Win16 apps are still multitasked cooperatively within the time slices allotted to them by the preemptive scheduler so they run essentially the same way as they do under Windows 3.x. Only Win32 apps can spawn additional threads; Win16 and DOS apps are limited to one thread each.

Another important enhancement that Chicago brings to Windows multitasking is desynchronized input queues. The input queue is where hardware-generated messages such as mouse clicks and key-strokes reside waiting to be retrieved by an application. If all running Win32 applications shared a common input queue (as Win16 applications do in Windows 3.x), an application that went for a long time



CRAIG BROWN'S

OVERHEAD PRESENTATION

WAS SO IMPRESSIVE

NO ONE NOTICED THE

GUACAMOLE ON HIS TIE.

without retrieving a message would suspend other applications trying to retrieve messages by clogging the input queue.

Chicago sidesteps this problem by assigning each application its own input queue. Multiple 16-bit apps running in Chicago's Win16 subsystem share a single input queue and behave as they do under Windows 3.x. But because this input queue is separate from the ones allocated to Win32 apps, a misbehaving Win16 app will not affect its Win32 counterparts.

Symmetric multiprocessing (SMP), the ability to drive several processors at once by running different threads on different CPUs, remains—among Microsoft OSs—the sole domain of Windows NT. Chicago does not support multiprocessing in any form.

FILE SYSTEMS

Versions of Windows up to and including 3.1 run on top of DOS and rely on real-mode DOS services to perform file I/O. As a result, protected-mode Windows incurs a performance hit every time a file is accessed. Chicago features a 32-bit file

system called VFAT (Virtual File Allocation Table) that provides a faster, protected-mode path to the disk and back. VFAT is also compatible with FAT volumes, so you won't have to reformat your hard disk to install Chicago.

Speed considerations aside, what end users will find the most enticing about VFAT is its support for long file names. VFAT file names can contain up to 255 characters (DOS limits you to the familiar 11-character 8.3-style filenames). DOS apps run in VMs will also have access to long filenames, but only if the apps are rewritten to include long filename support. Applications that do not support long filenames can still access files assigned long filenames by using 8.3 aliases created by the operating system. Chicago's IFS manager also supports CD-ROM and network file systems; all Chicago file systems will support long filenames.

Protected-mode file systems, of course, need protected-mode device drivers. Chicago will support both protected-mode drivers and existing real-mode drivers. Real-mode support is essential for

boot devices and for compatibility with existing hardware and software, but protected-mode drivers are the wave of the future. Protected-mode drivers are dynamically loadable and unloadable virtual devices that run in ring 0 and have a flat-model 32-bit view of the system.

REQUIRED HARDWARE

What kind of hardware will you need to run Chicago? The stated goal is for Chicago to run on any system that Windows 3.1 can run on with no decrease in performance. The actual minimum system Microsoft is targeting is a 386 or 486 with 4MB of RAM.

Such goals have a history of falling by the wayside in the real world. Even today's Windows 3.1 clearly requires an 8MB 486 to run snappily. But Microsoft seems resolved to stand by its stated goals. If Chicago's size can be kept down, its speed targets should be reachable, because of the 32-bit construction. It's still too early to say for sure, but a move from Windows 3.x to Chicago may require little or no additional investment in hardware.



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Under Construction: Tools & Applications

While end users can expect a fairly smooth transition from Microsoft Windows 3.1 to Chicago, programmers will have plenty to wrestle with: a new API (application programming interface), new interface elements, new types of operating-system functionality, and a new emphasis on documents rather than applications.

But the result of these efforts will be a new generation of 32-bit application programs that are faster, richer in features, and more versatile than the 16-bit apps that we use today. The burden of creating these programs falls to developers, who are charged with the exciting but unenviable task of keeping up with the fast-evolving Windows programming model.

WIN32, CHICAGO STYLE

From a programmer's standpoint, developing for Chicago is much more akin to developing for Windows NT than for Windows 3.1. Programmers writing Chicago applications will write to a nearly complete subset of the Win32 API that is richer and more extensive than Win32s

BY JEFF PROSISE



(the 32-bit API for Windows 3.1). The Chicago implementation of Win32 will include nearly everything that the Windows NT implementation does, with the exception of event logging, security, service control, Unicode (the 16-bit replacement for ASCII), and certain Graphics Device Interface (GDI) transforms

such as shearing and rotation. Virtually everything else is supported, including threads, memory-mapped files, long filenames, paths and Beziers, structured exception handling, Remote Procedure Calls (RPC), and the flat 32-bit memory model.

Chicago will also introduce a few new features to Win32 that aren't currently implemented in Windows NT. New API functions for Image Color Matching, for example, will allow programs to define color in a device-independent color space so that colors will be rendered the same regardless of output device, whether a monitor, ink jet printer, or film recorder.

A logical color space will be just another GDI object that an application can

elect to create, like a logical font. Once selected into a device context, that color space can be used to transform colors between devices. What this means to someone using a desktop publishing program and a color printer is that colors on the printed page will exactly match the colors on the screen.

Other new API elements introduced in Chicago will include functions for file merging and reconciliation, the first manifestation of which will be a Briefcase utility that allows files modified on a laptop to be reconciled with (and in some cases merged with) files on a desktop PC. Chicago will also add telephony functions for adding fax and telephone support to applications (including a Unimodem driver for device-independent modem programming), event notifications supporting Plug and Play, and built-in modules called viewers that permit data files created by other application programs to be viewed in their native contexts.

According to Microsoft, some of the features that are supported by Chicago but not by Windows NT will be added to NT a few months after Chicago's release. But some, such as Image Color Matching, will probably not appear until Cairo, the 1995 release of Windows NT slated to feature an object-oriented interface and fully distributed file system. This makes Chicago the only current showcase for some of Microsoft's most advanced operating-system features.

PORTING PAINS

Porting an application from Windows 3.0 to Windows 3.1 was a relatively painless process, because neither the base operat-

Building Applications

We compare today's APIs, object models, and operating-system resources with planned future developments.

Here Today

Microsoft Windows 3.1: Supports Win16 and Win32s APIs. Supports Win16 and DOS applications. Supports Component Object Model (COM). Supports short filenames only.

OS/2 2.1: Supports OS/2 and Presentation Manager APIs. Supports Win16 and DOS applications. Supports System Object Model (SOM). Supports long filenames. Windows 3.x apps run in separate or common virtual machines.

Microsoft Windows NT: Supports NT implementation of Win32 API. Supports Win16 and DOS applications. Supports long filenames, advanced C2-level security, and Unicode. Windows 3.x apps share a common virtual machine.

Where We're Headed

Chicago*: Supports Chicago implementation of Win32 API. Supports COM. Supports long filenames. Win16 apps share common virtual machine, DOS apps run in separate virtual machines. Supports Image Color Matching and Plug and Play.

Workplace OS for PowerPC*: Supports OS/2 and Presentation Manager APIs. Supports SOM, OpenDoc, and Plug and Play.

Cairo*: Supports Win32 API. Supports Win16 and DOS applications. Supports long filenames. Windows 3.x apps run in separate virtual machines, but OLE 2.0 links between them are supported. Supports Unicode, Image Color Matching, and Plug and Play.

* Preliminary feature set, based on prerelease information.

Chicago

ing system nor the API changed significantly. Porting a Windows 3.1 application to Chicago will involve considerably more work. The first step in converting a 16-bit Windows 3.1 application program into a 32-bit Chicago application is to resolve the normal porting issues associated with Win32—the widening of handles, message parameters, and int (integer) data types from 16 to 32 bits, for example, and the replacement of obsolete Win16 API functions with their Win32 equivalents. The next step is to review the application's code and consider redesigning it to take advantage of specific Win32 features. For example, some tasks that a program currently performs synchronously might work better if spun off into asynchronous threads. If your program reads and writes large files, memory-mapped files might provide better performance than conventional file I/O methods.

If you've already ported your app to Windows NT, you've come this far already. Now there are additional issues to consider. For example, Chicago adds several new control types (collectively known as common controls) to the mix: tabbed dividers, toolbars, column headers, sliders, spin buttons, status bars, and progress indicators, to name a few. (Microsoft has said that these controls will also appear in the Daytona release of NT scheduled for this spring, and in Win32s, Version 1.2.) Chicago applications should support long filenames and Universal Naming Convention (UNC) path names, which will require changes for apps that currently assume DOS naming conventions. Code supporting owner-draw controls—controls such as a button or list box that are drawn by an application instead of the operating system—will need to be rewritten to achieve visual consistency with the 3-D controls in Chicago. Even push buttons, which have a 3-D look in 3.1, are likely to undergo a face-lift.

One must also consider the impact that usability enhancements will have on application programs. For example, Chicago apps that deal with hardware in any way should be cognizant of Plug and Play messages broadcast when a device is inserted or removed (for more information, see the section "Under Construction: Plug & Play," later in this story).

Apps that check the screen size or default font size at start-up and use these measurements to compute their own screen metrics may fail when the screen resolution changes dynamically. (Chicago can change the screen resolution without restarting.)

NEW TOOLS

If you're still programming Windows in C, now is a good time to evaluate the object-oriented C++ language, especially in 32-bit capable, Windows-hosted development environments such as Borland C++ 4.0, Microsoft Visual C++, 32-bit Edition, or Symantec C++ Professional 6.1. These tools include application frameworks such as the Microsoft Foundation Classes (in Microsoft Visual C++ and Symantec C++) or Borland's ObjectWindows Library (in Borland C++) that encapsulate significant portions of the Win32 or Win32s C APIs. In the near future, they will also help ease complex programming tasks such as the addition of OLE 2.0 support to your applications.

OLE 2.0 is coming to front and center as a key component in Chicago's—and future versions of Windows'—document-centric view of the world. But those who have tried it know that OLE programming is an unenviable pastime.

In the 16-bit world, Microsoft's Visual C++ 1.5 currently ships with MFC 2.5, an application framework that hides more than 20,000 lines of OLE 2.0 code in a handful of prepackaged, reusable classes. An associated OLE code generator lets programmers add OLE 2.0 functionality with a mouse click. That's 20,000 lines you don't have to write and debug to make your application support OLE 2.0 features such as in-place activation, drag-and-drop, and structured storage. Currently, there is no support for generating OLE 2.0 code in any 32-bit Windows development tool, but this is expected soon from Microsoft and other vendors.

The importance of OLE cannot be overstated. In Chicago, OLE is more than just a mechanism for integrating diverse applications; it's a major contributor to the document-centric personality of the desktop shell. For example, verbs that an application registers in the OLE database will appear on document shortcut menus, which the user can pop up by clicking a

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document object with the right mouse button. If your documents are stored as compound files with summary information embedded (including the document title, author, and creation date, for example), the Properties menu item will display that information. Applications that do not support OLE 2.0 run the risk of being second-class citizens in the land of Chicago. By supporting OLE 2.0, your apps will migrate more easily to Cairo and beyond.

EXISTING APPLICATIONS

The vast majority of existing Windows apps will run fine under Chicago, albeit in a nonpreemptive 16-bit environment. Those that don't should be rare, because the Win16 environment that Chicago provides closely approximates that of Windows 3.1. Even long filenames will not pose an insoluble problem, because Chicago will pass 8.3-style filenames to applications that use Win16 or DOS file functions. These filenames might not make a lot of sense—how can an operating system sensibly condense a 255-character filename into eight characters?—but they won't bring an application crashing to the ground, either.

It's too early to know how robust Chicago will be when it comes to running DOS applications, although it should do the job at least as well as Windows 3.1 and Windows NT do. As a stopgap, early releases of Chicago feature a "Single MS-DOS Application" mode which literally stops all running tasks and resets the processor to real mode. It is still unclear whether users will have the option of booting the shipping version of Chicago to a character-mode command line.

The bigger question is whether you will want to keep using those 16-bit DOS and Windows apps? Some applications—desktop shells, File Manager extensions, and pop-up program launchers, for example—will be just plain obsolete. Those that aren't might look weak next to their 32-bit cousins. Chicago apps may well be faster, more responsive (thanks to the preemptive, multithreaded environment in which they run), less prone to crashing, and richer in features. If Chicago lives up to its promises, there will be compelling reasons—finally—to begin a wholesale shift to a 32-bit computing environment.

Under Construction: Networking

Time was when networking took a backseat in Microsoft's operating-system philosophy. Chicago, even at this early stage, shows that those days are gone. Instead of treating networking as something separate, Chicago's designers have integrated LAN capabilities into everything from its 32-bit device drivers to its toolbar.

Unless the final release of Chicago takes an unexpected turn, every computer running Chicago will have network file-server and client capabilities. You won't need any other software. Using Chicago's desktop, making shared links to printers, fax boards, and CD-ROM drives promises to be an easy drag-and-drop operation. Built-in network messaging will integrate e-mail, fax, and scheduling programs that Microsoft will probably ship in the box. Above all, Chicago is designed to drop into an existing NetWare, Unix, or VINES network without major disruption, or it can be the infrastructure for a new large or small network installation.

NO SURPRISE

None of these Chicago features comes as a surprise. Microsoft poured the foundation and erected the framework of its networking infrastructure in Windows for Workgroups and Windows NT. Microsoft networks use the Server Message Block (SMB) protocol to format requests for file and print services between client and server PCs and rely on the NetBEUI protocol to carry the packets across the network. NetBEUI (NetBIOS Extended User Interface) is fast and efficient in networks up to a few dozen nodes, but larger installations need a protocol able to cross routers between local networks. For such tasks, the TCP/IP protocol developed for

BY FRANK J. DERFLER, JR.



the Internet will probably ship in the Chicago package as well. Chicago is also expected to include software that allows certain types of applications such as management programs to use the NetWare IPX protocol.

During installation, Chicago (like Windows for Workgroups) will automatically search for

and recognize the LAN adapter installed in a PC from a list of more than a hundred. Microsoft plans to include 32-bit Virtual Extended Drivers (VxDs) for many popular adapters, but vendors can also ship their own VxDs for top performance. Menu selections will make it easy to add interoperability with NetWare through the Novell NCP and IPX protocols and to add TCP/IP.

Many of the networking features delivered in Windows for Workgroups and Windows NT—specifically administration, messaging, and remote access communications—should be carried a step further in Chicago. Windows NT already has a network dial-in capability, letting callers access the network via modem. Chicago is expected to extend that capability with more protocols and service features for network callers. The new dial-in system will handle a variety of communications links, such as regular telephone lines or ISDN service, through parallel and serial ports. Administratively, there will be new options for granting access to resources based on user names and new ways to control and configure servers remotely from across the network and through dial-up links.

WELL CONNECTED

A computer running Chicago will be well connected in other ways. The improved Messaging API (MAPI) will interact with

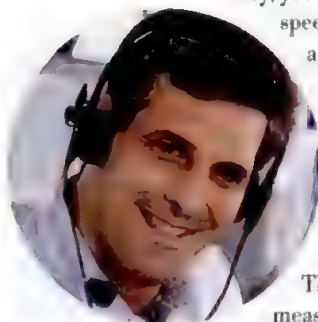


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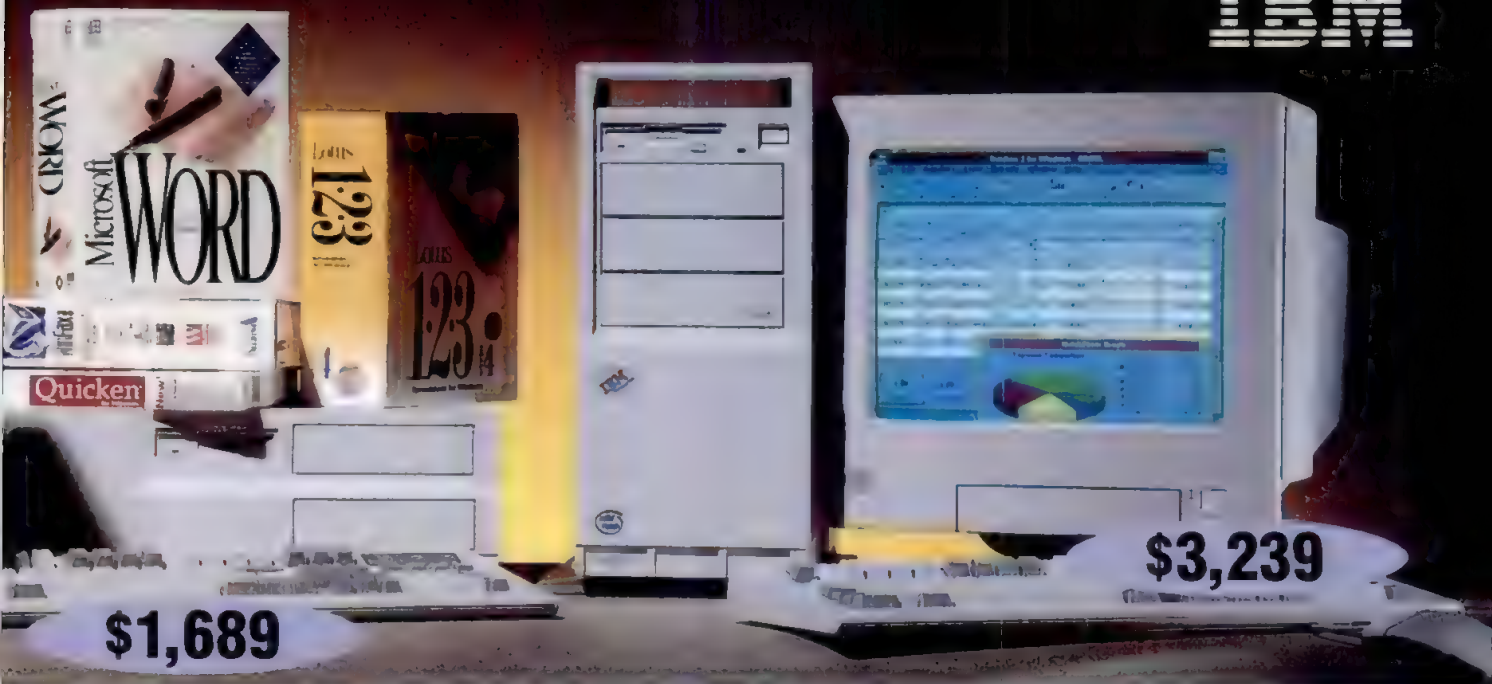
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Chicago's built-in connectivity should include Microsoft's recently released Telephony API. This service hosts applications from third parties like Dialogic Corp. that will tightly integrate a Chicago-based PC with telephone services.

Some of Chicago's networking strengths will grow from its general features such as Plug and Play and the Installable File System (IFS). The Plug and Play architecture should dull the pain of installing LAN adapters. This architecture also makes it possible to dock and undock laptops automatically and to change PCMCIA drivers on the fly while maintaining the network connection.

The IFS, in combination with the extended Windows WNet interface and the Windows Sockets interface should make it easy to use Chicago as an environment for client programs using multiple network operating systems. Network redirectors will run under Chicago's IFS so you can access networks using different protocols with less chance of conflict.

If you have NetWare, Sun NFS, and VINES servers on the same network, it should be easy to load the client software for each network into each PC running Chicago. You can do this today to some extent using the Microsoft NDIS, shareware Packet Driver, or Novell ODI LAN card interfaces, but the Chicago environment, with a new transport interface in the WNet API and the Windows Sockets API, will make it possible to load more redirectors with less conflict. Microsoft says it will deliver the network-client software you need for "common environments," including NetWare and TCP/IP.

Overall, Chicago is designed for networking like a duck is designed for water. It does other things well, but networking is an integral part of everything it does.

Under Construction: Plug & Play

BY JEFF PROSISE



The last time you added a new adapter card or other device to your PC, did everything work properly the first time around? No? If you've experienced the frustrations of wrestling to install a new device, you might be interested in a new technology that will see its first implementation in Chicago. It's called Plug and Play, and it promises to bring order to the current chaos of conflicting IRQ, DMA, I/O, and memory address settings. It will even permit devices to be added and removed on the fly, with the full knowledge and cooperation of the operating system and running applications.

At the moment, Plug and Play is only a specification. But Microsoft, along with an impressive list of hardware vendors including Compaq, Intel, and Phoenix Technologies, is working feverishly to turn it into reality in time for Chicago's release.

SHOULDN'T BE A HASSLE

Behind Plug and Play is the simple notion that adding a new device or adapter to a PC shouldn't be such a hassle. Currently, when you install a new device, its generally your responsibility to set parameters such as the IRQ number and I/O addresses for each new device so that they do not conflict with the current system configuration. This is usually done with jumper settings or DIP switches. Plug and Play would transfer this responsibility to the operating system, with a little help from the devices themselves and their device drivers.

On a fully-equipped Plug-and-Play system, adding a new sound board or SCSI device would be as simple as plugging it in and powering up. The operating system would recognize that a new device

is present and automatically load the appropriate drivers. It would also configure the device to use unclaimed hardware resources. The process works in reverse too. The Plug and Play system would recognize when a device is removed and unload the associated device drivers to prevent them from using memory

needlessly. It would also free associated hardware resources so other devices could use them.

The concept of self-configuring devices is not new. Micro Channel and EISA buses have long had provisions for automatic configuration built-in, but neither bus is widely accepted. What Plug and Play brings is a general solution framework that works with all buses and device types.

HOW IT WORKS

A Plug and Play system consists of three components: a Plug and Play operating system, a Plug and Play BIOS, and Plug and Play devices with their device drivers, all working in concert. If any component is missing, Plug and Play's ability to function is diminished. The Chicago implementation will provide some support for existing, non-Plug-and-Play hardware, but to fully benefit from Plug and Play, you must upgrade or replace your old hardware.

Each time a Plug and Play system is booted, the system builds a complete description or *enumeration* of the installed devices. This process is supervised by a component of the operating system known as the configuration manager, which calls other software components called enumerators to identify the installed devices.

After the enumeration process is

Chicago

complete, the configuration manager uses modules called resource arbitrators to weigh the various resource needs and determine a configuration that is satisfactory to all devices. The configuration manager then passes configuration parameters to the various devices and device drivers, which configure themselves accordingly. Configuration parameters are stored in a centralized system registry so they can be restored the next time the system is booted.

Obviously, some of this can't work if, say, a device is incapable of communicating its resource requirements, or it is unable to accept configuration commands from the configuration manager. That's why full Plug and Play support requires hardware designed to meet the requirements set forth in the specification.

PORTABLE DEVICES

Because the Plug and Play specification supports dynamic loading and unloading of devices and device drivers, it becomes possible to remove a portable PC from a docking station without turning it off. A Plug and Play operating system would react appropriately, unloading device drivers that were no longer required and notifying running applications of the new hardware configuration. Applications would also be given the opportunity to "veto" the undock-

ing process if parting could have undesirable consequences—for example, if disconnecting the hard disk would prevent a critical file transfer from being completed.

Plug and Play accommodates dynamic system events by broadcasting notification messages to applications and device drivers. This mechanism meshes perfectly

with Chicago's event-driven, message-based nature. If a device's status changes, the Plug and Play BIOS notifies the operating system. The OS then broadcasts a system-wide message informing interested parties that a device was just inserted or removed, for example, or asking for permission to remove a device

LEGACY DEVICES

Obviously, not everyone is going to rush out tomorrow and replace all their hardware with Plug and Play equipment. So Plug and Play does what it can to accommodate existing (or legacy) devices. Chicago will be able to identify many legacy devices and in some cases determine what resources they're using so Plug and Play devices can steer clear.

It's unclear at the moment how extensive this support will be and the fact remains that you'll need new hardware for the Plug and Play component of Chicago to work as intended. So, while Chicago is an important step toward making Plug and Play a reality, the dream of flawless self-configuration is still a ways off. □

*Chicago is an important
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Plug and Play a reality, but
the dream of flawless
self-configuration is still a
long way off.*

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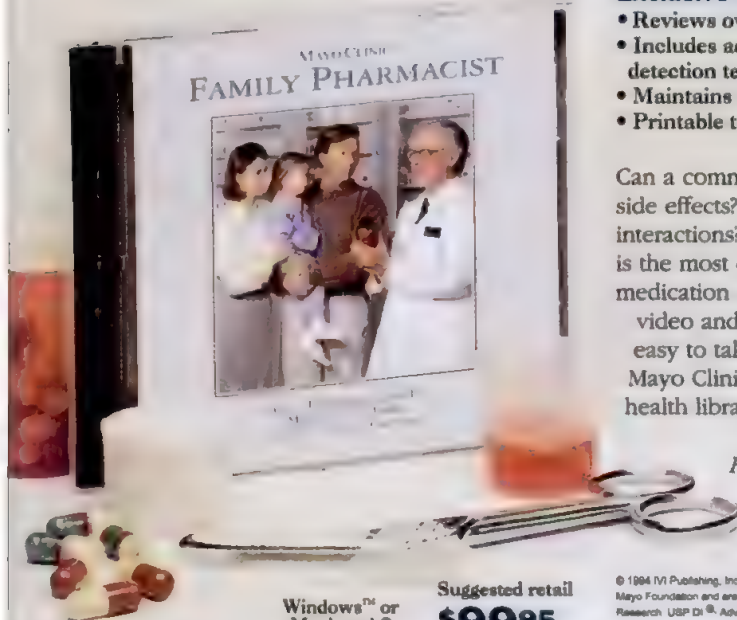


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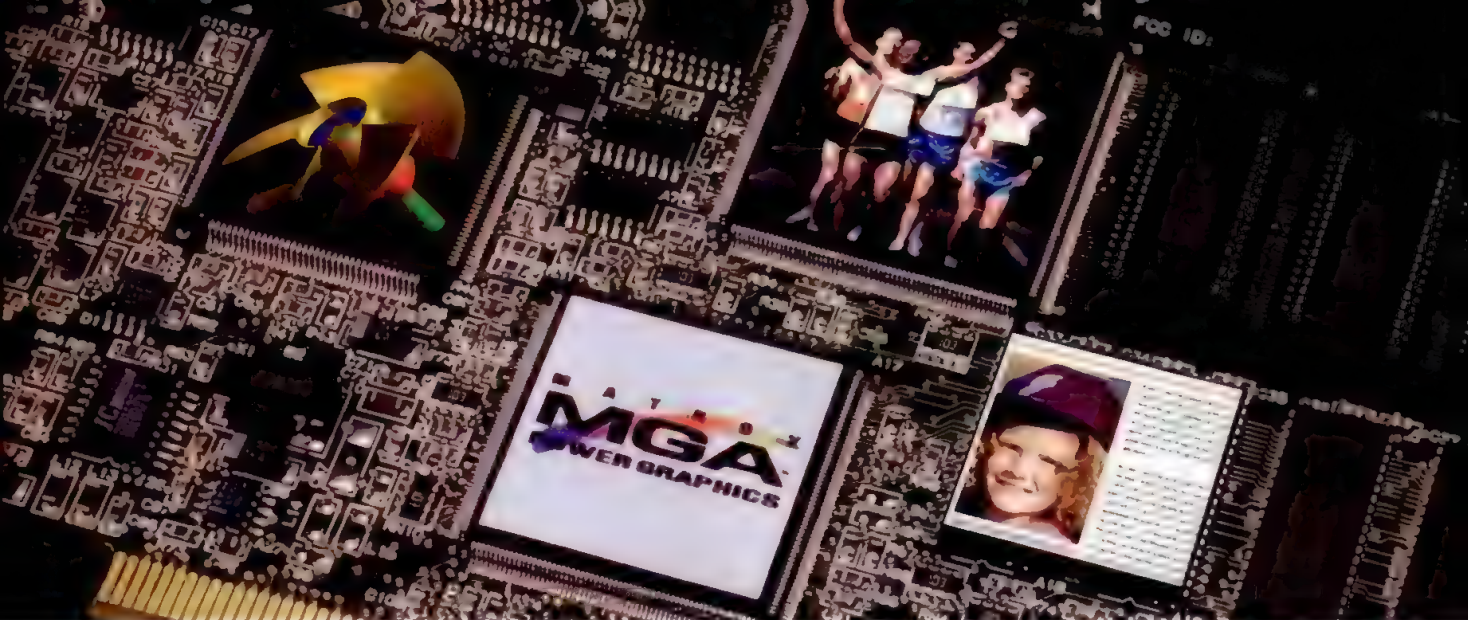
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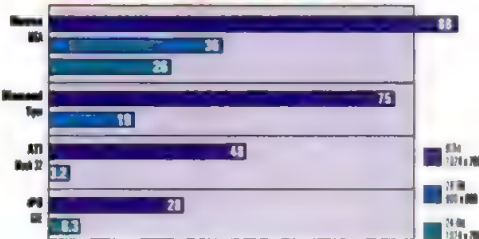
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BIG AUDIO Dynamite

By John R. Quain

An explosion in multimedia software and thriving CD-ROM drive sales are creating a demand for better desktop sound. Last year, according to Dataquest, 3.2 million sound cards were sold in the United States. This year, sales are expected to be nearly doubled.

Business audio is also making its presence felt, but there are still more reasons to buy a sound card for home entertainment than for business. Applications like voice recognition and integrated telephony are in their infancy, and the lack of a universal compression standard means it is still impractical for most users to share large numbers of audio files.

REVIEW CRITERIA

To judge this year's crop, PC Magazine Labs tested sound boards that could record and play back 16-bit, 44.1-kHz stereo sound and support the .WAV file format (requirements that are part of the

Sound board sales are exploding, but does quantity mean quality? PC Magazine Labs tests 24 16-bit sound cards to see if claims of CD-class audio are true.

► IN THIS REVIEW

<i>Advanced Gravis UltraSound</i>214	<i>Communications Adapter</i>238
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Multimedia PC Level 2 standard). The 44.1-kHz refers to the number of times per second a sound sample is taken (44,100), and 16-bit refers to the size of each sample. The units also had to be shipping in quantity by the time of our testing. Our total of 24 boards came from Advanced Gravis Computer Technology, Antex Electronics Corp., Aztech Labs, Cardinal Technologies, Creative Labs, Diamond Computer Systems, Focus Information Systems, IBM Personal Computer Co., ImagiMedia Corp., Logitech, Media Vision, Microsoft Corp., Multiwave Innovation, Orchid Technology, Roland Consumer Products Group, Toptek Technology, and Turtle Beach Systems. The following manufactur-

ers either declined to participate or did not have shipping products (or did not send working boards in time for review): ACS Computer (USA), Ad Lib MultiMedia, Alpha Systems Lab, Antec, CompuMedia Technology, Criterion Computer Corp., Digicom Systems, Genoa Systems Corp., Jovian Logic Corp., Media Magic, MIDI Land, National Semiconductor Corp., New Media, ProMedia Technologies, Verbex Voice Systems, and Yamaha Corp. of America.

The 24 boards in this review were subjected to a suite of standard audio tests in 16-bit, 44.1-kHz mode using an Audio Precision System One, the same testing equipment used to evaluate high-fidelity

stereo equipment. Claims of CD-quality sound for audio cards are based on the fact that 16 bits and 44.1 kHz are the same sampling size and rate used in making audio CDs. Even so, PC Labs' tests show that, in general, what you are used to hearing from your home CD player is better than what you'll get from a PC. This year, Turtle Beach Systems' \$399 MultiSound retains its coveted spot as the only sound board that can truly boast CD-quality sound. There are now, however, two high-end rivals worthy of consideration: the \$399 IBM WindSurfer Communications Adapter and the \$395 Antex Model Z1.

Buyers should also beware of two other factors: installation and quality control. Sound boards are notoriously difficult to install. Jumpers settings and DMA and IRQ conflicts are typical hurdles you'll have to overcome. There are only four boards here that offer installation relief: the Diamond SonicSound LX, Focus 2 the Max MusicMaker, Logitech SoundMan 16, and Microsoft Windows Sound System 2.0. Later this year or early in 1995, Windows 4.0 and the Plug and Play standard introduced by Intel, Phoenix Technologies, Microsoft, and Compaq should make sound board installation easier.

Quality control among sound board manufacturers is also not quite where it should be. We had to order 39 boards in order to obtain results from 24 products.

HIGHLIGHTS

Sound Boards

THESE 24 SOUND BOARDS range in price from \$149 for the Diamond SonicSound LX to \$599 for the Roland RAP-10. We reviewed only boards that support 16-bit sampling and playback, since 8-bit boards have become near-commodity items suited primarily to low-cost entertainment use.

TRUE CD-QUALITY AUDIO remains elusive, despite specs that imply otherwise. Many of the boards we tested showed poor response at the low and high ends of the audible frequency range, high distortion levels, and limited stereo imaging. But there are promising

signs: The Turtle Beach MultiSound that sets the standard for professional-quality sound has nearly been matched by the Antex Model Z1 and the IBM WindSurfer Communications Adapter.

BUSINESS AUDIO gets a boost from the \$219 Microsoft Windows Sound System 2.0, the first product that makes a truly compelling argument for the concept. More than anything else, the Windows Sound System's strength is its software, which includes voice-command capabilities, a text-to-speech "proofreader," and TrueSpeech compression. The software is available separately for compatible boards, too.

THE SUPERIOR SOUND of wavetable synthesis, which mimics instruments by using real samples of their sound, is becoming increasingly prevalent. Eight of the reviewed products are wavetable-based, and 16 are FM synthesis boards, of which 9 have optional wavetable upgrades.

QUALITY CONTROL is a problem for sound board manufacturers: Many of the products that were shipped to us for review simply didn't function or were seriously deficient and required replacement. And installation can still be a hassle, so don't expect instant gratification.

TRENDS: WAVETABLES AND DSPS

Unlike Windows' .WAV files, which contain digitized sounds, MIDI files contain instructions for playing back music. The continuing trend in MIDI is away from the Fisher-Price toy sounds of *FM synthesis* and toward the more realistic and euphonious *wavetable lookup* approach. Inexpensive FM synthesizer chips, like Yamaha's OPL-3 synthesizer, use a combination of operators or sine waves—in Yamaha's case, four—to recreate the sounds of the different instruments they are instructed to play. Wavetable lookup, on the other hand, uses actual recorded samples of instruments. Wavetable results vary, depending on the number of instruments and notes stored. Of the boards reviewed here, 16 are FM-based and 8 come with wavetable capabilities.

Another emerging trend in sound cards is the increased use of digital signal processors, or DSPs. Fourteen of the products reviewed here come with DSPs on-board. In contrast to dedicated or application-specific integrated circuits (ASICs), DSPs can be programmed to adapt to changing tasks and are especially adept at processing algorithms. This makes them ideal for relieving the CPU from the chores associated with processing and compressing digital audio. The Antex Model Z1 (\$395) uses a Texas Instruments DSP for managing compression, and Cardinal Technologies' cards use an Analog Devices DSP, the features of which can be upgraded via software. IBM goes a step further, using its DSP to add a 14.4-kilobit-per-second modem, 9.6-Kbps fax, and a digital answering machine to the \$399 WindSurfer.

COMPRESSION DEPRESSION

One minute of stereo audio recorded in a 16-bit sample size at 44.1 kHz in the .WAV file format eats nearly 11MB of disk space. To reduce the strangulating effects of storing audio files, several vendors use ADPCM (Adaptive Differential Pulse Code Modulation) compression, which reduces file sizes by half or three



EDITORS' CHOICE

- *General-purpose audio* **Creative Labs Sound Blaster 16 Basic Edition**
- *Professional audio* **Turtle Beach MultiSound**
- *Business audio* **Microsoft Windows Sound System 2.0**

Again this year, the Turtle Beach MultiSound (now \$399) wins an Editors' Choice for providing the best all-around sound quality. For professional musicians, serious multimedia composers, and die-hard audiophiles, there's no alternative. The Turtle Beach Multi-

Sound Monterey, which will replace the MultiSound about the time you read this, will add the capability to download wavetable samples and expand on-board RAM. List price will remain \$399. For many users, the MultiSound's lack of a standard microphone input—to say nothing of its price—will put it out of the running. More appealing for mainstream use is the \$199.95 Creative Labs Sound Blaster 16 Basic Edition, which sells for a mere \$100 street price. The Basic Edition offers a solid set of features, above-average sound quality, and plenty of expandability: Both a wavetable synthesis daughtercard and a digital signal processor chip are available as upgrades. In addition to easy installation, it offers ironclad compatibility.

If your goal is the elusive "business audio" solution, the Microsoft Windows Sound System 2.0, list-priced at \$219, is as close as you can come. It installs effortlessly, and the software is extraordinarily well integrated. Voice recognition and text-to-speech utilities make

this package especially appealing for business applications. New in this version is Microsoft's TrueSpeech compression algorithm, which squeezes voice recordings to one-tenth their usual size without perceptibly reducing fidelity.

The hardware in the Windows Sound System 2.0 is unchanged from the previous release. For \$79, Microsoft sells the software separately for use as an upgrade or with compatible boards from other manufacturers.

HONORABLE MENTION

Two boards that deserve honorable mention for features beyond the ordinary are the \$395 Antex Model Z1, with its excellent sound quality and programmable DSP, and the \$399 IBM WindSurfer Communications Adapter, which provides fax/modem and digital answering machine capabilities. Three more that earn an honorable mention for easy installation are the \$149 Diamond SonicSound LX, \$169 Focus 2 the Max MusicMaker, and \$199 Logitech SoundMan 16.

quarters. However, a simple fact of audio life is that if you use compression, you lose sound quality. Partly because the compression quality is so poor, there is no

ADPCM standard—de facto or otherwise. Creative Labs uses a proprietary hardware approach, while Microsoft is pushing the Business Audio ADPCM design developed with Compaq.

One emerging compression standard is the Motion Pictures Experts Group (MPEG) standard, which works with both audio and video compression and is gaining support in the non-PC world from products like Philips CD-I player. Only

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one product, the Advanced Gravis UltraSound (\$199) offers MPEG compression and decompression. Aztech Labs and ImagiMedia offer MPEG decompression only, and Xing Technology offers an MPEG upgrade option (\$79) for any board that has an Analog Devices ADSP2115 DSP chip. With a potential compression ratio of 12:1 and full-motion-video MPEG CD-ROM titles expected soon, this standard may catch on quickly.

In the meantime, the primary audio business applications involve voice annotations and recordings, prompting several vendors to include two international telephone PCM (pulse code modulation) compression standards: the European *A-Law* specification and North American/Far East *Mu-Law* standard. Unfortunately, neither has the voice quality or PC industry backing needed to gain a foothold.

Microsoft has introduced a more promising new codec designed specifically for voice called *TrueSpeech*, which offers 10:1 or better compression. Developed by DSP Group for telephone answering machines and other telephony

applications, *TrueSpeech* is included as part of the Microsoft Windows Sound System 2.0. *TrueSpeech* is not intended for recordings of Beethoven's piano sonatas, but its faithfulness in spoken-word recordings is quite good. In comparisons with mono voice recordings made at 8 bits, 11 kHz, *TrueSpeech* annotations were nearly as pleasing to the ear while saving considerable storage space. A 10-second voice recording, for example, normally takes 117K in 8-bit 11-kHz mode. The same file takes only 13K when *TrueSpeech* is used.

Voice recognition should also be considered when choosing a sound board. Most of the companies offer simple voice-recognition applets, such as Microsoft Voice Pilot (based on Dragon Systems technology) and Media Vision's *ExecuVoice*. These programs rely mostly on discrete speech-recognition techniques that let you utter simple commands to navigate around Windows apps. The inaccuracy of these programs and their limited vocabularies can limit their usefulness. If you need serious voice-recognition capabilities such as

speech-to-text functions, you will need to look at dedicated products such as IBM's *VoiceType* and Verbex Voice Systems' *Listen for Windows*.

Finally, a text-to-speech application can come in handy for proofing spreadsheets and other business documents. Of the 24 boards reviewed here, 7 came with text-to-speech applications.

FINAL CAVEATS

Although nearly all the boards in this roundup claim to be compatible with Sound Blaster boards, only those of two companies are strictly compatible: Creative Labs, the originator of the de facto standard, and IBM, which has licensed the technology from Creative Labs. The other "compatible" boards generally rely on reverse-engineered chips, and Creative Labs has taken at least three to court, Cardinal, Media Vision, and Orchid.

If you're buying a separate CD-ROM drive, consider a sound board with an on-board controller so that you can save an expansion slot. Five manufacturers—Antex, Cardinal, Creative Labs, Diamond Computer Systems, and Media Vision—offer cards with controllers for SCSI CD-ROM drives, and ten companies offer proprietary interfaces for specific non-SCSI drives from companies like Mitsumi, Panasonic, Philips LMS, and Sony.

Microphones are another issue. Unlike cassette decks and other home audio gear, sound cards have no standard microphone input impedance (measured in ohms). Often a microphone from one card won't work with another, so check that the card either comes with a compatible mike or that one can easily be found with the right impedance.

Some boards come with tiny low-end speakers, but you'll want to shop around for a pair that does justice to the 16-bit capabilities of these sound boards. The 4-watt amplifiers on the majority of these sound cards aren't sufficient to drive standard stereo speakers, and since amplifiers located inside a PC can add distortion as well as volume, two of the leading boards in this roundup, the Turtle Beach MultiSound and the Roland RAP-10, offer little or no amplification. Be sure to ask for self-powered speakers that are magnetically shielded to prevent any interference with your monitor.

Suitability to Task: 16-Bit Sound Boards

The 24 sound boards reviewed here run the gamut in features and sound quality. Some boards are targeted at the games and entertainment market, while others are directed at the professional who needs to put together multimedia applications or the business user who wants to annotate spreadsheets and control applications with voice commands. We rated each board's suitability to task according to the criteria listed below.

To score high in the **professional quality audio** category, a card must offer 16-bit, 44-kHz recording and playback capabilities with sound quality near that of CD audio. Other features we look for include a coprocessor or DSP to take on compression and sound-processing functions; a well-implemented mixer; .WAV recording and editing and MIDI sequencer software; a wavetable MIDI synthesizer chip; and a connector for MIDI In, Out, and Thru.

To score high in suitability for **business audio**, a sound board has to be inexpensive and easy to

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	○	○	○
Business audio	●	●	○	○
Games and education	●	●	●	○
Games and education	●	●	●	●

install and use. It also has to include a CD-ROM interface (preferably SCSI) and at least 4:1 file-compression support. Sound packages that come with voice annotation, speech synthesis, voice recognition, and simple presentation software are more likely to score highly in this category than other packages. Points are also given to units that include a microphone (preferably the hands-free type) and speakers, as well as ports that are clearly labeled.

To score high in suitability for **games and education**, the product has to be inexpensive and easy to install and operate. It also has to offer a CD-ROM interface (preferably SCSI), DOS support, Sound Blaster and Ad-Lib compatibility, and a joystick port.

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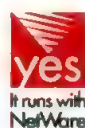
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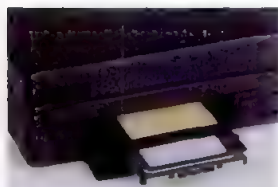
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Advanced Gravis Computer Technology Ltd.

Advanced Gravis UltraSound

BY JONATHAN HILL

With a list price of \$199 (and a street price that can go as low as \$130), the UltraSound provides a low-cost entry into the world of wavetable and three-dimensional sound, but mediocre sound quality and a lack of business software limit its use to education and games. By itself, the UltraSound offers only 8-bit recording with 16-bit playback, though adding a daughtercard (\$149) gives you 16-bit recording. The \$249 UltraSound Max, which wasn't shipping in time for this review, is essentially the same design but includes 16-bit recording and a Philips/Sony CD-ROM AT-style interface.

Bass frequency response was poor, and total harmonic distortion, intermodulation distortion, and channel separation were worse than for most of the boards reviewed here.

Unlike most wavetable-based boards, which store digitized audio samples in on-board ROM, the UltraSound uses your hard disk to store 5.6MB of supplied digi-

SUITABILITY TO TASK

Advanced Gravis UltraSound

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio				
Business audio				
Games and education				

tized samples. It supports patch caching, a feature of Windows 3.1's Multimedia extensions. Applications that support patch caching download only those patches required for a particular set of MIDI data to the 512K on-board RAM (upgradable to 1MB). The UltraSound ships with Patch Maker software, which lets you record new sample files or edit existing ones. Installation was relatively straightforward.

Advanced Gravis has added Roland MPU-401 emulation and has updated its Creative Labs Sound Blaster emulation and Windows driver files since our last sound card review ("Sound Boards: Coming of Age," April 27, 1993). The board now ships with Modus (a Windows MOD player), Turtle Beach Systems'

Wave Lite for Windows (Windows mixer), Howling Dog Systems' Power Chords (a guitar-based synthesizer and drum machine program), Midisoft's Recording Session (sequencer software), and WinSoft SoundStation (Windows record and playback software). No microphone or headphones are packaged with the board.

► **Advanced Gravis UltraSound.** List price: \$199. SCSI CD-ROM adapter (daughtercard), \$69; Philips/Sony CD-ROM AT-style interface, \$49; 16-bit recording upgrade (daughtercard), \$149; MIDI connector with joystick interface, \$49; 1MB RAM upgrade, \$30. Advanced Gravis Computer Technology Ltd., 1790 Midway Ln., Bellingham, WA 98226; 604-431-5020; fax, 604-431-5155.

Circle 490 on reader service card

Antex Electronics Corp.

Antex Model Z1

BY JONATHAN HILL

The \$395 Antex Model Z1 may seem pricey for an FM synthesis board, but it's a high-quality product that professional audio users will appreciate. The Model Z1's audio quality is excellent—in the same class as the pace-setting Turtle Beach MultiSound. On our tests, the frequency response was practically flat, and in most cases the board's signal-to-noise ratio, channel separation, and total harmonic distortion were better than for the other units tested. That, combined with support for SCSI CD-ROM drives and a DSP that can handle multiple compression formats, makes the Model Z1 an excellent choice for producing heavy-duty multimedia. Optional programmers' kits for the board's Texas Instruments TMS320C25 DSP chip also make the Model Z1 appealing for corporate IS managers who want to develop custom applications integrating audio effects.

You won't find the board at a discount; and although the Model Z1 offers a joystick port and Creative Labs Sound Blaster compatibility, its price puts it out of the running for games-only use. For serious MIDI work, Antex offers a 32-voice wavetable MIDI synthesis option called Z.WAV (\$195). Based on the new Ensoniq OTTO synthesizer engine, Z.WAV offers Roland MPU-401 compat-

ibility and MIDI buffering on top of 175 MIDI instrument samples.

The Model Z1 supports 4:1 ADPCM compression in DVI, OKI, and IMA flavors. A sister card, the \$595 Model Z1e (not tested) adds MPEG compression capabilities.

SUITABILITY TO TASK

Antex Model Z1

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio				
Business audio				
Games and education				

The board's documentation contains a thorough discussion of the principles of digital-to-analog conversion and audio compression schemes. Although the documentation covering the setup process was relatively sparse, installation was uneventful.

The Model Z1 ships with DOS and Windows drivers, a demo program, and a Windows-based sound mixer utility called Antex Mixer. Voyetra Technologies' Multimedia Toolkit for Windows and DOS, scheduled for inclusion in the package, was unavailable during our testing period. Programmers can use the optional SPDK toolkit (\$500) to program the on-board DSP in C or the optional ADK toolkit (\$750) to create BASIC programs that control the board.

► **Antex Model Z1.** List price: \$395. Z.WAV wavetable synthesis daughtercard, \$195; ADK audio developer's toolkit, \$750; SPDK DSP developer's toolkit, \$500. Antex Electronics Corp., 16100 S. Figueroa St., Gardena, CA 90248; 800-338-4231, 310-532-3092; fax, 310-532-8509.

Circle 491 on reader service card

Aztech Labs Inc.

Aztech Sound Galaxy Basic 16 Aztech Sound Galaxy Pro 16 Extra

BY JAMES KARNEY

The Aztech Sound Galaxy Basic 16 (\$169) and Aztech Sound Galaxy Pro 16 Extra (\$219) offer a solid set of features and great software bundles. The Sound Galaxy



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Basic is a natural for entertainment or educational use; the Sound Galaxy Pro is appealing for business applications.

The Sound Galaxy Pro 16 sells at a discount for about \$179; the Sound Galaxy Basic 16 Extra, for about \$149. Both products support FM synthesis and can be upgraded with a wavetable synthesis daughtercard called Wave Power (\$169, or about \$149 with a discount).

Both cards reproduced CD-quality (44.1-kHz) audio without audible drops or clicks, though the Sound Galaxy Basic had a bit of popping at lower sampling rates when playing back voice recordings. In general, we thought the Sound Galaxy Pro 16 Extra sounded slightly better

than the Sound Galaxy Basic 16. In our objective tests, the Sound Galaxy Basic 16 showed very high distortion levels; the Sound Galaxy Pro 16 Extra was about average on most measures, although its distortion was worse than average on the digital recording/playback tests.

Installation was easy, especially for the Sound Galaxy Pro 16 Extra, which has a smooth, software-only configuration. Setting up the Sound Galaxy Basic 16 was a bit more complicated because it required more drivers and also added an unusually large number of entries to AUTOEXEC.BAT.

The Sound Galaxy Pro 16 Extra uses a Yamaha OPL-3 FM synthesis chip. An auto-adjust filtering feature lets you filter out distortion introduced by digital-to-analog conversion, according to Aztech; you can manually override the filtering for special effects. The Sound Galaxy Pro 16 Extra supports Mitsumi, Panasonic, and Sony CD-ROM drives; a SCSI CD-ROM interface is a \$49 option.

The Sound Galaxy Basic 16 has a CD-ROM interface, too, but it supports only Mitsumi, Panasonic, and Sony CD-ROM drives.

Both cards come with headphones and

are bundled with Voyetra's AudioStation for Windows; SoundScript for both DOS and Windows, an audio calendar; Say It voice annotation; voice mail for NetWare; WinDAT sound editor; Jukebox, for playing .WAV, MIDI, and CD music in the background; an audio screen saver; a DOS command-line MIDI player; and a

collection of sound tracks. The Sound Galaxy Pro 16 Extra adds CommVoice (a voice recognition program) and a microphone.

The Wave Power upgrade conforms to the General MIDI sound set, offering 128 authentic instrument samples and 47 percussion sounds. The output was more realistic with the add-on card installed, and the includ-

ed Midisoft Studio software gave us excellent control over MIDI composition. The software lets you note music in standard notation with drag-and-drop operation on up to 32,000 tracks.

► **Aztech Sound Galaxy Basic 16.** List price: \$169. *Wave Power daughtercard, \$169. Aztech Sound Galaxy Pro 16 Extra.* List price: \$219. *Wave Power daughtercard, \$169; SCSI extension board, \$49.* Aztech Labs Inc., 46707 Fremont Blvd., Fremont, CA 94538; 800-886-8859, 510-623-8988; fax, 510-623-8989.

Circle 492 on reader service card

Cardinal Technologies Inc.

Cardinal Digital Sound Pro 16 Cardinal Digital Sound Pro 16 Plus

BY JAMES KARNEY

The Cardinal Digital Sound Pro 16 and the Cardinal Digital Sound Pro 16 Plus may not be the best-sounding cards around, but they're inexpensive and capable enough for games, everyday business use, or low-end multimedia. The Sound Pro 16 has a list

price of \$159 and a discounted price of about \$120; the Sound Pro 16 Plus, which adds a SCSI CD-ROM interface absent on the basic unit, lists for \$229 and sells for about \$179. These FM synthesis boards can be easily upgraded to support wavetable synthesis, too. (The upgrade lists for \$59 and sells at a discount for about \$39.)

The sound quality of both cards was perceptibly inferior to that of many of the other units we tested. When we played back compact disks, for example, clicks were audible in the background. We heard them again when we made voice recordings at lower sampling rates. Our objective tests uncovered high distortion levels, low signal-to-noise ratios, and poor bass response.

Installation is straightforward: Each card has only two jumpers (you can select from eight IRQ lines and six DMA channels via software), and setup menus are simple. Adding an option (such as the wavetable ROM) is a bit more complicated because the add-on configuration routines aren't as intuitive.

These two Sound Pro 16 boards are compatible with major audio standards including Creative Labs Sound Blaster, the Microsoft Windows Sound System, and Compaq Business Audio. With each card you get the Voyetra Sound Software Collection (a collection of tools for both business and audio-production applications); Voyetra's AudioStation (a software stereo system); Say It (a sound annotation utility); WinDAT and DOS-

SUITABILITY TO TASK

Aztech Sound Galaxy Basic 16

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☒	☐
Business audio	☒	☒	☒	☐
Games and education	☒	☒	☒	☐

SUITABILITY TO TASK

Aztech Sound Galaxy Pro 16 Extra

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☒	☐
Business audio	☒	☒	☒	☐
Games and education	☒	☒	☒	☐

SUITABILITY TO TASK

Cardinal Digital Sound Pro 16

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☐	☐
Business audio	☒	☒	☒	☐
Games and education	☒	☒	☒	☒

SUITABILITY TO TASK

Cardinal Digital Sound Pro 16 Plus

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☐	☐
Business audio	☒	☒	☒	☐
Games and education	☒	☒	☒	☒



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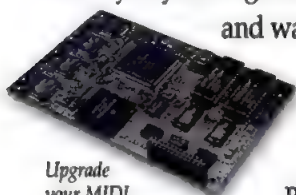
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*All prices listed are manufacturer's suggested retail

	Sound Blaster 16 Basic Edition	Sound Blaster 16 MultiCD	Sound Blaster 16 SCSI-2	Sound Blaster AWE32
Format	16-bit stereo	16-bit stereo	16-bit stereo	16-bit stereo, 32-note polyphony
Advanced Signal Processing Upgradability	Yes	Yes	Yes	Included
Wave Blaster Upgradability	Yes	Yes	Yes	Not applicable
CD-ROM Compatibility	Creative Labs	Sony, Mitsumi, Creative Labs	Any SCSI or SCSI-2	Sony, Mitsumi, Creative Labs
Bundled Hardware		Microphone	Microphone	Microphone
Bundled Software	Monologue for Windows Creative WaveStudio Creative Sound LE Creative Talking Scheduler Creative Mosaic	Software Toolworks Multimedia Encyclopedia HSC Interactive SE PC Animate Plus Monologue for Windows Creative WaveStudio Creative Sound LE Creative Talking Scheduler Creative Mosaic Creative VoiceAssist	Software Toolworks Multimedia Encyclopedia HSC Interactive SE PC Animate Plus Monologue for Windows Creative Ensemble Creative WaveStudio Creative Sound LE Creative Talking Scheduler Creative Mosaic Creative VoiceAssist	HSC Interactive SE Cakewalk Apprentice for Windows Creative WaveStudio Creative Sound LE Creative Mosaic Creative Ensemble Creative VoiceAssist Creative TextAssist
Suggested Retail	\$199.95	\$249.95	\$279.95	\$399.95
W/Advanced Signal Processing	Not applicable	\$299.95	\$329.95	Included



THE 16-BIT SOUND STANDARD.

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CREATIVE LABS, INC.

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Benchmark Tests: Sound Boards

What the Numbers Mean

The Turtle Beach MultiSound is once again the board that most nearly achieves the ideal of genuine compact disk sound quality. It now has two worthy competitors, however: the Antex Model Z1 and the IBM WindSurfer Communications Adapter, which doubles as a fax/modem and a digital answering machine. But the Antex and IBM cards each had a negative gain, a problem if you need to equalize recording levels from different input sources.

Five other boards—the two Cardinal Digital Sound Pro boards, the two Creative Labs Sound Blaster boards, and the Orchid SoundWave 32—met our objective criteria for adequate sound quality. But in subjective listening tests, the Cardinal and Orchid products came up short, generating audible clicks, pops, and dropouts— anomalies that these objective results may not reflect but which we discuss in the individual reviews.

Many manufacturers have improved the overall performance of their products by incorporating on-board voltage regulators, which greatly improves signal-to-noise ratios. On manufacturers' agendas for next year: selection of better audio integrated circuits, elimination or bypassing of electrolytic coupling capacitors, and further attention to the importance of flat frequency response and low distortion.

How We Tested

To judge the audio quality of sound boards, we relied not only on the aural impressions of our reviewers but on objective, instrument-based tests that are routinely used to evaluate home and professional stereo equipment. To generate and analyze the test signals we used the accepted industry-standard instrument, the Audio Precision System One. (The boards themselves were installed in a standard Compaq Deskpro 486/33M system.) We also monitored the waveforms visually on an oscilloscope and aurally on a top-quality component stereo system. All boards were tested in 16-bit stereo mode at a 44.1-kHz sampling rate, so we could determine whether sound boards fulfill their claims of CD-quality recording and reproduc-

tion. If you need sound only for tasks such as annotating a spreadsheet or playing games, the results of these stringent tests will not be as relevant as the subjective evaluations in the individual product reviews.

TEST CATEGORIES

Each board's test results are divided into four major categories, shown in the accompanying tables for Preamplifier, Power Amplifier, Digital Playback, and Recording and Playback.

Preamplifier. The preamplifier is the mixer portion of the board, which controls the board's various analog audio inputs and outputs. It provides software-based volume controls (often separate controls for left and right channels) for each input, and it frequently also includes tone and channel balance controls and master output level controls. The output from this purely analog stage is fed internally to the card's digital recording circuits, and externally to one or two jacks on the rear of the card. The preamplifier jack on the rear of the card, usually labeled Line Out, is designed for connection to a stereo amplifier or to a pair of *powered* loudspeakers. We used this jack to obtain overall system measurements.

Power Amplifier. To drive headphones and standard, unpowered speakers, many a board also contains a small power amplifier of its own that drives a separate rear-panel speaker jack. (The Aztech Sound Galaxy and Creative Labs Sound Blaster boards each use a single output jack, which can be switched between preamp and power amp use by setting jumpers on the board.) Using these tiny on-board power amplifiers (which produce less than 2 watts per channel, although many manufacturers claim higher output levels) invariably degrades the quality of audio signals. We therefore measured power amplifier performance separately, using a standard 8-ohm precision resistor in place

of an actual loudspeaker.

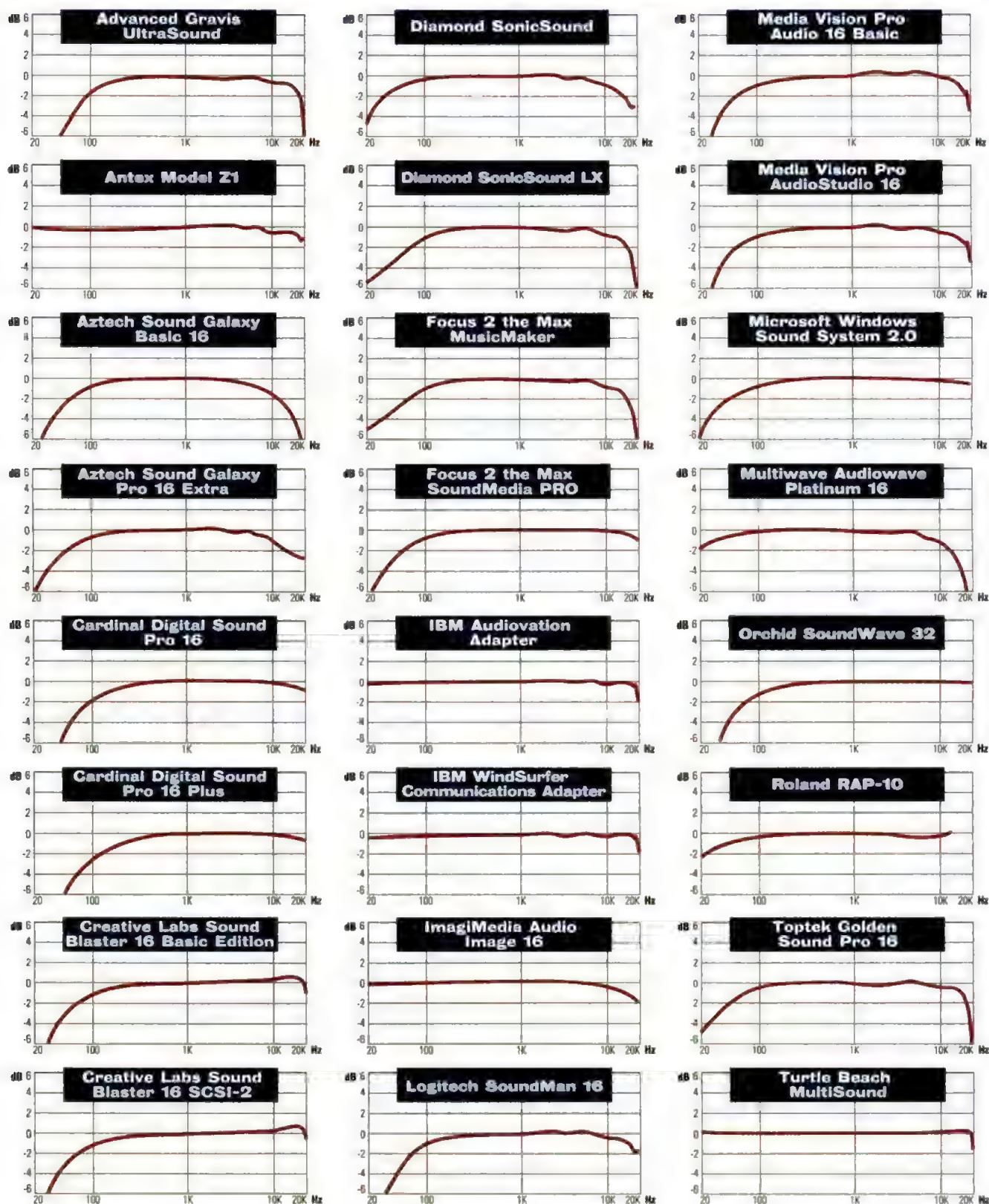
Digital Playback. Each board has a digital-to-analog converter (DAC) which translates digitally recorded .WAV files into analog audio signals. To test this section of the card requires measuring the playback of calibrated .WAV files containing specific frequencies and precisely known levels, and such files are not commercially available. So we created our own high-accuracy .WAV files by using a Turtle Beach 56K recorder to capture in .WAV format the digital output of a high-grade CD player while it played the appropriate tracks of the industry-standard CBS-1 Test CD. This technique prevents the loss of calibration that intervening digital-to-analog and analog-to-digital conversions inevitably introduce.

Recording and Playback. The remaining portion of each card (ignoring the MIDI circuits, for which no objective standards exist) contains the analog-to-digital converter circuitry necessary to translate audio signals into a series of bits that can be stored as a .WAV file. Because the recording-level indicators provided by the various board manufacturers differ in their calibration and do not permit setting the levels accurately before actually beginning to record, we used Turtle Beach's optional WAVE software with all the boards tested. (The sole exception was the IBM WindSurfer Communications Adapter, which proved incompatible with WAVE but came with its own software that performed a similar function.) This software enabled us to preview and record .WAV files at the same levels, waveforms, and frequencies as those of our calibrated playback files. The recording and playback measurements provide an overall indication of all audio imperfections arising in the mixer and the digital-recording and digital-playback segments of each board.

ANALYZING THE RESULTS

While dedicated audio buffs will want to review all the test results reported, most buyers could quickly narrow their choices by starting with the recording and playback **Frequency Response** curves. Ideally, a board should handle all frequencies from 20 Hz to 20,000 Hz uniformly. The overall recording/playback "curve" shown in each graph should thus be a straight line at the 0-dB level. A dropoff of perhaps 2 dB can be expected in the 18- to 20-kHz range because of the sharp treble cutoff filter required to eliminate all frequencies above 22.05 kHz (half the 44.1-kHz sampling rate). Apart from this, however, top-quality stereo electronic components routinely have no trouble keeping deviations in frequency response between 20 Hz and 20,000

RECORDING AND PLAYBACK FREQUENCY RESPONSE



Benchmark Tests: Sound Boards

Hz within 1 dB of their midfrequency (1-kHz) value. Even merely good components will deviate by no more than 2 dB across the range.

Looking at the graphs, however, it is clear that most of the boards' frequency response curves fall off drastically in the bass end, and a few have poor response toward the top of the treble area as well. Nevertheless, although a loss of 3 dB or more at either end of the audible range is an indication of poor design and will be unacceptable to serious audiophiles, you can get away with diminished bass if the loudspeakers you intend to use cannot produce significant output in the 20- to 80-Hz

range. The speakers in a conference room or in an inexpensive home system rarely have much effective output in the deep bass range, vital as that is to the full enjoyment of recorded pipe organs, synthesized rock, film tracks like *Gettysburg*, and such works as *Also sprach Zarathustra*. Only the few boards with full, flat frequency response can pretend to offer CD-quality sound.

After frequency response, the two most important audio specifications are signal-to-noise ratio and distortion. The **Signal-to-Noise Ratio (S/N ratio)** is simply the ratio, in decibels (dB), of the maximum undistorted output of the board (the

signal) and the inevitable electronic noise—mostly hum and hiss—generated by the board's own circuitry. At the background sound levels where hum and hiss usually occur, the human ear does not perceive all frequencies equally, so a standardized *A-weighting* network has been developed to reflect the "perceptible annoyance" value of residual electronic noise. The *A-weighted* signal-to-noise ratios are listed in the tables under the heading **Signal-to-Noise Ratio (A-weighted)**, and are more significant than the unweighted figures. The larger the number, the better (quieter) the board. A top-grade home component will have an *A-weighted*

PREAMPLIFIER

	Sensitivity (volts)	Output Level (volts)	Gain (dB) ▲	Total Harmonic Distortion plus Noise (percent) ▼		Intermodulation Distortion (percent) ▼		Signal-to-Noise Ratio (dB) ▲		Signal-to-Noise Ratio (A-weighted, in dB) ▲		Channel Separation (at 10 kHz, in dB) ▲
				Maximum	0.5V	Maximum	0.5V	Maximum	0.5V	Maximum	0.5V	
Advanced Gravis UltraSound	0.497	2.23	13.0	0.240	0.040	0.280	0.054	84.1	68.5	87.6	68.2	53.2
Antex Model Z1	2.050	1.80	-1.1	0.070	0.018	0.237	0.049	88.8	77.3	91.3	82.8	79.4
Aztech Sound Galaxy Basic 16	0.133	2.16	24.3	0.329	0.304	0.965	0.381	76.9	65.2	81.7	68.8	52.9
Aztech Sound Galaxy Pro 16 Extra	0.100	0.94	19.5	0.020	0.032	0.083	0.062	76.4	71.0	78.2	72.8	81.0
Cardinal Digital Sound Pro 16	0.721	1.54	6.8	0.014	0.039	0.031	0.056	77.4	68.4	84.7	75.4	73.5
Cardinal Digital Sound Pro 16 Plus	0.712	1.48	6.4	0.010	0.024	0.015	0.025	80.7	72.5	86.0	77.0	72.6
Creative Labs Sound Blaster 16 Basic Edition	0.590	1.14	5.7	0.075	0.025	0.034	0.076	83.4	77.6	86.5	80.7	68.4
Creative Labs Sound Blaster 16 SCSI-2	0.757	1.18	3.9	0.071	0.025	0.239	0.079	86.0	79.1	88.7	81.9	65.4
Diamond SonicSound	0.400	1.16	9.2	0.021	0.058	0.022	0.104	77.5	70.3	81.1	73.9	63.4
Diamond SonicSound LX	0.440	1.01	7.2	0.017	0.015	0.027	0.020	81.9	76.9	85.4	79.7	58.7
Focus 2 the Max MusicMaker	1.780	1.02	-4.7	0.022	0.013	0.037	0.020	85.4	79.2	87.7	81.7	58.5
Focus 2 the Max SoundMedia PRO	0.246	0.44	5.0	0.042	0.045*	0.010	0.064*	71.5	66.9*	75.2	70.6*	60.1
IBM Audiovention Adapter	0.473	1.01	6.6	0.257	0.106	2.760	0.661	75.0	72.4	77.5	75.4	74.6
IBM WindSurfer Communications Adapter	1.340	0.97	-2.8	0.015	0.019	0.042	0.034	79.5	73.8	82.4	76.6	74.6
ImagingMedia Audio Image 16	0.428	0.31	-2.8	0.070	0.118*	0.210	0.214*	68.9	59.6*	74.6	68.6*	50.0
Logitech SoundMan 16	0.158	4.27	28.6	0.088	0.075	0.364	0.071	72.3	65.2	76.4	67.2	45.8
Media Vision Pro Audio 16 Basic	0.118	2.73	27.3	0.063	0.184	0.041	0.123	72.0	61.1	74.2	66.1	70.0
Media Vision Pro AudioStudio 16	0.108	1.14	20.5	0.080	0.052	0.102	0.076	67.0	65.7	69.0	67.7	71.1
Microsoft Windows Sound System 2.0	1.520	2.20	3.5	0.030	0.117	0.042	0.124	71.7	58.7	79.3	66.3	63.6
Multimedia Audiowave Platinum 16	0.747	1.56	6.4	0.013	0.013	0.040	0.018	86.1	77.2	88.1	79.2	64.1
Orchid SoundWave 32	0.622	0.59	-0.6	0.032	0.036	0.058	0.048	73.3	72.0	76.7	75.4	63.4
Roland RAP-10	0.498	1.08	8.7	0.020	0.049	0.055	0.131	81.8	75.1	85.1	78.5	75.6
Toptek Golden Sound Pro 16	0.586	1.60	20.0	0.331	0.096	2.340	0.442	81.7	73.0	86.1	75.8	68.9
Turtle Beach MultiSound	0.158	1.29	18.2	0.007	0.016	0.014	0.028	83.1	76.0	86.7	79.6	55.5

POWER AMPLIFIER

	Sensitivity (watts)	Output Level (watts) ▲	Total Harmonic Distortion plus Noise (percent) ▼		Intermodulation Distortion (percent) ▼		Signal-to-Noise Ratio (dB) ▲		Signal-to-Noise Ratio (A-weighted, in dB) ▲		Channel Separation (at 10 kHz, in dB) ▲
			Maximum	0.5V	Maximum	0.5V	Maximum	0.5V	Maximum	0.5V	
Advanced Gravis UltraSound	0.218	0.76	0.167	0.141	0.727	0.680	74.6	75.9	78.0	76.4	43.7
Antex Model Z1	1.980	0.35	0.071	0.033**	0.232	0.101**	89.3	84.4**	90.9	87.8**	58.4
Aztech Sound Galaxy Basic 16	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
Aztech Sound Galaxy Pro 16 Extra	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
Cardinal Digital Sound Pro 16	0.378	1.49	0.196	0.108	0.635	0.286	65.2	60.6	72.3	67.7	51.8
Cardinal Digital Sound Pro 16 Plus	0.380	1.53	0.131	0.063	0.445	0.136	71.7	67.3	75.6	71.0	52.2
Creative Labs Sound Blaster 16 Basic Edition	0.582	0.13	0.075	0.029**	0.302	0.075**	82.1	82.2**	84.9	84.7**	51.8
Creative Labs Sound Blaster 16 SCSI-2	0.308	0.84	0.045	0.040	0.110	0.072	78.9	78.5	81.3	80.9	53.7
Diamond SonicSound	N/A	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
Diamond SonicSound LX	0.152	1.25	0.424	0.087	0.296	0.124	77.0	76.7	82.0	79.4	48.2
Focus 2 the Max MusicMaker	0.809	1.25	0.180	0.085	0.378	0.114	80.2	76.6	82.3	78.7	48.6
Focus 2 the Max SoundMedia PRO	0.288	1.05	0.380	0.236	0.878	0.727	73.2	70.2	76.6	73.7	73.7
IBM Audiovention Adapter	N/A ①	N/A ②	N/A	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
IBM WindSurfer Communications Adapter	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
ImagingMedia Audio Image 16	0.425	0.23	0.352	0.258**	1.170	0.800**	60.3	56.1**	67.8	63.8**	52.4
Logitech SoundMan 16	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
Media Vision Pro Audio 16 Basic	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
Media Vision Pro AudioStudio 16	0.100	1.74	0.288	0.383	0.738	0.791	67.8	66.3	69.7	68.4	46.4
Microsoft Windows Sound System 2.0	1.124	0.43	0.504	0.681**	0.677	0.780**	68.9	62.5**	76.5	70.2**	55.7
Multimedia Audiowave Platinum 16	0.760	1.50	0.147	0.080	0.425	0.239	86.0	81.1	88.7	83.9	47.8
Orchid SoundWave 32	0.394	1.52	0.170	0.115	0.317	0.315	70.0	58.8	73.0	72.9	46.9
Roland RAP-10	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②
Toptek Golden Sound Pro 16	0.310	0.70	0.483	0.434	1.846	1.703	56.5	57.5	61.3	61.2	61.2
Turtle Beach MultiSound	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②

▲ Higher scores represent better performance. ▼ Lower scores (or larger negative numbers) represent better performance.

* Because the unit could not produce 0.5V test output, we report results at 0.25V

** Because the unit could not produce 0.5W test output, we report results at 0.10W.

N/A ①—Not applicable. The unit's power amplifier was unable to drive an 8-ohm speaker load

N/A ②—Not applicable. The unit does not have a power amplifier

S/N ratio in excess of 85 dB. At less than about 75 dB, hum and hiss may become audible during silent passages and may contribute a certain amount of hard-to-identify sonic "grit" underlying the music itself.

Distortion is the other chief enemy of good sound reproduction. The **Total Harmonic Distortion plus Noise** (THD+N) is the total (root-mean-squared sum) of all spurious harmonic frequencies (plus the noise) generated within the board, expressed as a percentage of the undistorted output signal strength. Musical signals themselves are rich in *harmonics* (or overtones), which

are integer multiples of the basic frequency. The number and strength of these naturally occurring harmonics help produce the distinctive tonal qualities that enable you to distinguish among an oboe, a flute, and a violin when all three instruments play the same note. But the integrated circuit amplifiers that go into a sound board (or any other audio component) generate some harmonics of their own, which alter the timbre of the music signals passing through them. The lower the THD+N percentage, the better; measured THD+N values that exceed 0.1 percent are likely to be audible and indicate that the card has less than

optimal circuitry design.

When two or more tones are present simultaneously—as in almost all music—imperfect, real-world amplifiers generate not only harmonic distortion but **Intermodulation Distortion** (IMD) as well. Thus, if two tones—one at 60 Hz and the other at 1,000 Hz—are played at the same time, spurious frequencies of 940 and 1,060 Hz, 880 and 1,120 Hz, and so forth will be generated by the amplifier. Since these distortion products are harmonically unrelated to the music, they tend to add a strident, harsh edge to the sound. As with THD+N, lower IMD scores are preferable. Likewise, well-designed units will reduce IMD to less than 0.1 percent.

Because of the importance of the S/N ratio and distortion measurements, we tested these parameters on all boards both at their maximum output levels, where the numbers look best, and at a level of 0.5 volts (0.5 watts on power amplifier tests), which is a realistic estimate of the signal level you will probably use in practice.

Applying the guidelines mentioned earlier—namely, an A-weighted S/N ratio of at least 75 dB at the 0.5V output level and THD+N and IMD of less than 0.1 percent—eliminates all but 11 boards from contention. The remaining frequency-response curves can be divided into three categories. The boards boasting full frequency response from 20 Hz to 20 kHz are the Antex Model Z1, IBM WindSurfer, and Turtle Beach MultiSound. The boards with full treble response but weak bass performance are the two Cardinal Digital Sound Pro boards, the two Creative Labs Sound Blaster boards, and the Orchid SoundWave 32. The Multiwave Audiowave Platinum 16, Diamond SonicSound LX, and Focus 2 the Max MusicMaker are limited at both ends of the frequency range and are thus unsuitable for accurate sound reproduction.

FURTHER CONSIDERATIONS

One further specification, while it does not directly affect fidelity, should not be ignored because of its practical importance in recording and playing sound through a sound board. As a starting point for all our tests, we measured a board's

Sensitivity—that is, the amplitude of a signal at the input jacks required to produce a maximum undistorted signal level at the output jacks, with the volume control sliders up fully. By themselves, these numbers may be hard to relate to the equipment you intend to use with the board, but if you divide the output by the input and express the result in decibels (dB), you get the **Gain** of the board, which is very much worth considering.

A stereo preamplifier typically has a potential

DIGITAL PLAYBACK

	Output Level (volts)	Total Harmonic Distortion plus Noise (percent) ▼	Inter-modulation Distortion (percent) ▼	Signal-to-Noise Ratio (dB) ▲	Signal-to-Noise Ratio (A-weighted, in dB) ▲	Quantization Noise (dB) ▼	Channel Separation (at 10 kHz, in dB) ▲
Advanced Gravis UltraSound	1.107	0.075	0.167	71.5	71.5	-89.9	85.3
Antex Model Z1	0.978	0.041	0.126	79.0	82.7	-79.0	77.1
Aztech Sound Galaxy Basic 16	0.943	0.431	0.834	69.1	73.7	-87.2	55.2
Aztech Sound Galaxy Pro 16 Extra	0.613	0.024	0.058	73.7	75.8	-73.2	62.3
Cardinal Digital Sound Pro 16	1.090	0.181	0.258	55.3	62.4	-55.1	52.4
Cardinal Digital Sound Pro 16 Plus	1.100	0.114	0.227	62.6	66.0	-62.3	52.6
Creative Labs Sound Blaster 16 Basic Edition	1.002	0.030	0.093	78.5	82.8	-78.4	86.5
Creative Labs Sound Blaster 16 SCSI-2	0.980	0.025	0.076	74.6	77.4	-74.3	63.2
Diamond SonicSound	0.645	0.013	0.032	78.3	80.7	-78.0	80.5
Diamond SonicSound LX	0.540	0.029	0.050	70.7	72.5	-70.8	57.9
Focus 2 the Max MusicMaker	0.600	0.035	0.054	69.4	71.0	-69.4	57.9
Focus 2 the Max SoundMedia PRO	0.541	0.039	0.091	69.4	73.2	-69.6	60.1
IBM Audiovation Adapter	0.980	0.224	2.100	82.2	85.3	-80.5	88.9
IBM WindSurfer Communications Adapter	0.998	0.110	0.074	79.9	82.5	-80.0	75.5
ImagiMedia Audio Image 16	0.307	0.072	0.212	68.5	74.0	-69.3	60.9
Logitech SoundMan 16	1.180	0.032	0.076	70.2	72.3	-71.0	77.6
Media Vision Pro Audio 16 Basic	1.045	0.104	0.080	70.9	72.9	-71.1	75.3
Media Vision Pro AudioStudio 16	1.064	0.504	0.323	76.4	78.7	-62.7	64.0
Microsoft Windows Sound System 2.0	1.026	0.019	0.038	77.2	78.9	-74.3	70.0
Multiwave Audiowave Platinum 16	1.188	0.012	0.032	81.0	84.5	-80.1	63.9
Orchid SoundWave 32	0.683	0.035	0.097	74.5	77.8	-72.1	85.4
Roland RAP-10	0.828	0.317	0.155	79.1	82.6	-70.5	80.1
Toptek Golden Sound Pro 16	1.026	0.181	1.608	77.9	80.5	-63.9	73.7
Turtle Beach MultiSound	1.002	0.008	0.014	82.4	86.3	-81.1	73.3

RECORDING AND PLAYBACK

	Output Level (volts)	Total Harmonic Distortion plus Noise (percent) ▼	Inter-modulation Distortion (percent) ▼	Signal-to-Noise Ratio (dB) ▲	Signal-to-Noise Ratio (A-weighted, in dB) ▲	Quantization Noise (dB) ▼	Channel Separation (at 10 kHz, in dB) ▲
Advanced Gravis UltraSound	1.043	0.232	0.353	41.1	47.1	-55.5	55.5
Antex Model Z1	0.907	0.068	0.187	77.7	79.0	-77.1	86.4
Aztech Sound Galaxy Basic 16	0.810	0.398	0.474	64.4	68.3	-65.2	41.3
Aztech Sound Galaxy Pro 16 Extra	0.497	0.503	0.223	68.6	70.2	-68.4	59.8
Cardinal Digital Sound Pro 16	1.050	0.189	0.378	55.1	62.0	-55.0	50.5
Cardinal Digital Sound Pro 16 Plus	1.080	0.091	0.182	62.0	65.8	-62.1	50.0
Creative Labs Sound Blaster 16 Basic Edition	0.726	0.031	0.097	72.8	75.1	-71.7	57.4
Creative Labs Sound Blaster 16 SCSI-2	0.769	0.036	0.101	70.1	73.0	-70.5	54.5
Diamond SonicSound	0.532	0.025	0.044	75.4	77.8	-74.9	77.3
Diamond SonicSound LX	0.501	0.052	0.063	65.6	67.3	-66.2	56.4
Focus 2 the Max MusicMaker	0.588	0.048	0.078	68.6	69.3	-65.8	54.7
Focus 2 the Max SoundMedia PRO	0.505	0.526	0.060	68.3	71.7	-68.6	63.9
IBM Audiovation Adapter	0.940	0.210	2.010	77.4	79.8	-61.8	78.4
IBM WindSurfer Communications Adapter	0.958	0.017	0.044	77.7	80.4	-78.8	72.7
ImagiMedia Audio Image 16	0.252	0.839	2.570	49.1	51.4	-48.8	59.1
Logitech SoundMan 16	1.080	0.086	0.141	62.6	66.0	-62.4	44.5
Media Vision Pro Audio 16 Basic	1.014	0.110	0.107	68.8	71.8	-69.7	75.6
Media Vision Pro AudioStudio 16	0.917	0.135	0.086	72.5	74.5	-72.6	53.6
Microsoft Windows Sound System 2.0	1.040	0.084	0.306	67.3	69.5	-66.5	68.9
Multiwave Audiowave Platinum 16	1.077	0.042	0.083	59.8	61.7	-67.1	60.2
Orchid SoundWave 32	0.639	0.054	0.082	71.9	75.0	-70.1	81.0
Roland RAP-10	0.703	0.315	0.201	74.0	76.6	-68.3	81.8
Toptek Golden Sound Pro 16	0.963	0.957	1.830	73.8	78.0	-64.3	89.2
Turtle Beach MultiSound	1.009	0.009	0.016	80.9	84.4	-81.6	54.6

gain of 20 dB (a 10:1 voltage ratio). This lets you produce the same volume level in the room even when you switch between a cassette deck—the output of which may be as low as 0.2V—and a high-quality CD player, the output of which is typically 2V. (Home audio components generally have an output of approximately 0.5V.) A gain potential of about 6 dB (a 2:1 voltage ratio) is typical of current sound boards.

If a board has a negative gain rating, however—as do five of those tested, including the top-category IBM WindSurfer and the Antex Model Z1—this means that at all positions of its volume control slider you will get less output from the board than the input you fed into it. Only if you have an excess in the incoming signal's strength, which you usually cannot control, will you be able to pull the volume sliders down at all from their maximum position. And only if the sound board sliders are pulled part of the way down will you have the option of increasing the volume later. If you use a board with a negative or even a small positive gain rating, then the manufacturer has tied your hands in order to save the small cost of one additional transistor or integrated circuit. A unit with a high positive gain value, on the other hand, allows you a good deal of latitude in setting the board's volume control to an appropriate level.

DAT (recording tools); SoundScript (a multimedia authoring tool); MIDI Orchestrator (to create and play back MIDI files); JukeBox (an audio CD player); and a small collection of music clips.

Both Cardinal boards are based on the Analog Devices ADSP2115 digital signal processor. Because this DSP, unlike a fixed-function sound chip, is programmable, you can upgrade the cards' capabilities simply by buying a software upgrade. For instance, a \$79 upgrade from Xing Technology Corp. (805-473-0145) allows you to add 12:1 MPEG compression and decompression capabilities to complement the cards' standard A-Law and Mu-Law compression algorithms.

These two Sound Pro 16 boards offer external mini-jacks for a microphone, speakers, line input and output, and a game port. An internal connector lets you hook up audio output from an internal CD-ROM drive. Since the Sound Pro 16 Plus's 16-bit SCSI controller is from Adaptec, most SCSI-based CD-ROM drives and utilities should work without a hitch.

► **Cardinal Digital Sound Pro 16.** List price: \$159. **Cardinal Digital Sound Pro 16 Plus.** List price: \$229; *MIDI ROM upgrade for either board, \$59.* Cardinal Technologies Inc., 1827 Freedom Rd., Lancaster, PA 17601; 717-293-3000; fax, 717-293-3055.

Circle 493 on reader service card

Creative Labs Inc.

Creative Labs Sound Blaster 16 Basic Edition

Creative Labs Sound Blaster 16 SCSI-2

BY HOWARD ALEXANDER

The two latest Creative Labs Sound Blaster cards are not dramatically different from their predecessors, but their features and performance still place them among the better FM synthesis boards we tested. The Creative Labs Sound Blaster 16 Basic Edition, which lists for \$199.95 and can be found at a discount for just under \$100, is well suited to professional and business audio as well as to games and education. The Basic Edition can be upgraded to the now-discontinued Sound Blaster 16 ASP by adding a \$69.95 DSP chip.

In the SCSI-2 version, the Sound Blaster 16 is available either with or without a DSP chip. We tested the one that included the DSP; it lists for \$329.95 and sells for about \$230 or \$240. The Sound Blaster 16 SCSI-2 has a SCSI-2 interface run by an Adaptec controller instead of the Panasonic CD-ROM interface that the Basic Edition has.

Both Sound Blaster 16 cards produced audio output that was good though not

The importance of two other parameters will increase as the sophistication of sound boards improves. The **Channel Separation** figures are computed by playing (or recording and playing) a full-strength signal in one channel only and measuring the output from the undriven channel. Ideally, channel separation, on which the stereo effect directly depends, should be infinite—meaning that no signal whatsoever leaks from one channel into the other. In some advanced CD players, channel separation reaches 100 dB. In most of today's sound boards, however, more obvious imperfections would likely mask the beneficial effects of channel separation in excess of 50 dB on stereo imaging.

It should also be noted that on the Digital Playback and the Recording and Playback tables, the negative **Quantization Noise** numbers serve as a somewhat more accurate guide to residual noise than the usual S/N figures do. S/N ratios are calculated by driving a device to its full output, then removing the input signal and measuring the noise that remains. In a digital system, however, when the input signal is removed, no noise is generated within the converter. Quantization noise is measured in the presence of a signal and is listed as the number of dB below the maximum signal rather than as a signal-to-noise ratio per se.

Analysis written by Craig L. Stark

stellar. MIDI playback is handled by the ubiquitous Yamaha OPL-3 chip; for more realistic sound, you can add the optional \$249.95 Wave Blaster daughtercard (not tested), which includes the E-mu Proteus/1 wavetable synthesizer chip and General MIDI instrument patches. On our objective tests, the Sound Blaster cards produced good bass and excellent treble response with roughly average levels of noise and distortion.

The software-based volume controls had very little effect near the maximum end of the range and suddenly killed off the sound below the control's midpoint.

The Sound Blaster cards also share the

SUITABILITY TO TASK

Creative Labs Sound Blaster 16 Basic Edition

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	●	○
Business audio	●	●	●	○
Games and education	●	●	●	●

SUITABILITY TO TASK

Creative Labs Sound Blaster 16 SCSI-2

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	●	●
Business audio	●	●	●	○
Games and education	●	●	●	●

same installation procedure and program. The installation software checks that the Sound Blaster's IRQ, DMA, and address settings aren't already in use by another device. Thanks to this, installation proceeded smoothly.

Both units come with Soundo'LE (an OLE-server recording utility for voice); CD, MIDI, and .WAV files; Wave Studio (a .WAV file editor); Talking Scheduler (which converts text to speech for verbal reminders of appointments); Mosaic (a tile game); Jukebox (a MIDI player); and First Byte's Monologue for Windows (a text-to-speech synthesizer). The SCSI-2 version includes Grolier's Multimedia Encyclopedia on CD, HSC InterActive SE (a multimedia authoring tool), Pacific Motion Software's PC Animate Plus (an animation editor), and Creative Voice-Assist (a voice recognition utility).

Additionally, the Sound Blaster 16 SCSI-2 comes with QSound, which downloads an algorithm onto the board's proprietary DSP to create an impressive "three-dimensional" sound effect. The on-board DSP also allows for real-time (albeit proprietary) file compression, as well as A-Law and Mu-Law compression standards on both boards.

EDITORS' CHOICE

► **Creative Labs Sound Blaster 16 Basic Edition.**

List price: \$199.95. *Advanced Signal Processor*, \$69.95; *Wave Blaster Module*, \$249.95; *MIDI kit (includes cable and sequencing software)*, \$79.95; *pair of unamplified speakers*, \$79.95; *pair of powered speakers*, \$149.95. **Creative Labs Sound Blaster 16 SCSI-2.** List price: *without DSP*, \$279.95; *with DSP*, \$329.95. *Options: Same as above.* Creative Labs Inc., 1901 McCarthy Blvd., Milpitas, CA 95035; 800-998-5227, 408-428-6600; fax, 408-428-6611.

Circle 494 on reader service card

Diamond Computer Systems Inc.

Diamond SonicSound

Diamond SonicSound LX

BY TED NEEDLEMAN

Diamond Computer Systems, well-known for its Viper and Stealth video cards, has made a promising initial foray into the audio market with its Diamond Sonic-

The Sound Board That Comes with the System
This table shows which sound boards are bundled with selected desktop systems shipped by the top ten PC vendors. Vendor rankings are provided by G1 InfoCorp and are based on the number of DOS-based desktop systems sold in the U.S. to end users in 1993.

Rank	PC vendor	Product	Sound board bundled with selected configurations
1	IBM Corp.	IBM PS/1 lines IBM PS/2 Ultimedia lines IBM ValuePoint MVP Series	Creative Labs Sound Blaster 16 Basic Edition IBM Audio Capture and Playback Adapter Creative Labs Sound Blaster 16 Basic Edition
2	Compaq Computer Corp.	All Compaq lines	Creative Labs Sound Blaster 16 SCSI-2
3	Packard Bell Electronics Inc.	All Packard Bell lines	Packard Bell Forté 16
4	Dell Computer Corp.	All Dell lines	Creative Labs Sound Blaster 16 Basic Edition
5	Gateway 2000 Inc.	All Gateway lines	Aztech- or Media Vision-designed custom 16-bit board
6	AST Research Inc.	AST Advantage! line AST Bravo line AST Premia line	Creative Labs Sound Blaster 16-compatible or Media Vision Pro Audio Spectrum 16 Media Vision Pro AudioSpectrum 16 Media Vision Pro AudioSpectrum 16
7	Acer America Corp.	Acer Acros line AcerPower line	Creative Labs Sound Blaster 16 Basic Edition Creative Labs Sound Blaster 16 Basic Edition
8	NEC Technologies Inc.	NEC Ready 425CD2 line NEC Ready 433CD3 line	Media Vision Pro AudioSpectrum 16 Media Vision Pro AudioSpectrum 16
9	Epson America Inc.	Epson Endeavor line	Creative Labs Sound Blaster 16 Basic Edition or Media Vision Pro AudioSpectrum 16
10	Digital Equipment Corp.	All Digital lines	Media Vision Pro AudioSpectrum 16 or Microsoft Windows Sound System 2.0

Sound and Diamond SonicSound LX. The SonicSound LX, a basic FM synthesis board aimed at the game player or entry-level PC audio buyer, lists for \$149 and has a street price of around \$90 or \$100. (The SonicSound LX is almost identical to the Focus 2 the Max MusicMaker, also reviewed here.) The more capable SonicSound, which lists for \$299 and is widely available for about \$220, is targeted toward the business or professional user. It offers wavetable synthesis and an on-board DSP; enhanced General MIDI capabilities and rudimentary voice recognition are a \$129 option. Both cards support CD-ROM drives, include game (joystick) ports, and are Creative Labs Sound Blaster compatible.

Sound quality for both cards was generally well above average, although the SonicSound LX evinced poor bass response. As with many of the reviewed products, both boards demanded careful adjustment of input levels when recording to minimize noise. Both cards rely on software controls for setting output volume.

Both cards come with concise installation instructions, although documentation for the SonicSound was more extensive than that for the SonicSound LX. Installation was trivial: The boards' default settings worked on the first try.

The SonicSound LX is based on the

popular Yamaha OPL-3 FM synthesis chip. Its CD-ROM interface supports only drives from Mitsumi, Panasonic, and Sony. The board was shipped to us with Midisoft's Recording Session and Sound Impression, plus a collection of DOS utilities that let you record and play CD audio as well as .WAV and MIDI files. Diamond says that by the time you read this, it will be shipping Animation's Music Rack for Sound Impression in place of Midisoft's Sound Impression.

The more expensive SonicSound uses the Sierra Semiconductor Aria chip set and a Texas Instruments TMS320C25

SUITABILITY TO TASK				
Diamond SonicSound				
	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	●	○
Business audio	●	●	○	○
Games and education	●	●	●	○
SUITABILITY TO TASK				
Diamond SonicSound LX				
	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	●	○
Business audio	●	●	○	○
Games and education	●	●	●	●

► **SUMMARY OF FEATURES**

16-Bit Sound Boards



Products listed in alphabetical order

■ = YES □ = NO

	Advanced Gravis UltraSound	Antex Model Z1	Aztech Sound Galaxy Basic 16	Aztech Sound Galaxy Pro 16 Extra	Cardinal Digital Sound Pro 16	Cardinal Digital Sound Pro 16 Plus	Creative Labs Sound Blaster 16 Basic Edition
List price	\$189.00	\$395.00	\$189.00	\$219.00	\$159.00	\$229.00	\$199.95
General Features							
Maximum sampling rate (kHz)	48	48	44.1	44.1	44.1	44.1	44.1
Sound chip set	ICS GF1	Yamaha OPL3	Yamaha OPL3	Yamaha OPL3	Analog Devices ADSP 2115	Analog Devices ADSP 2115	Yamaha OPL3
On-board DSP manufacturer	N/A	T1	Analog Devices	Crystal Semi- conductors	Analog Devices	Analog Devices	Creative Labs (optional, \$69.95)
Amplifier (watts per channel)	4	0.25	4	4	2.5	2.5	4
IRQ levels supported	2, 3, 5, 7, 11, 12, 15	2, 3, 5, 7, 10, 11	2, 5, 7, 10	2, 5, 7, 10, 11, 15	3, 5, 7, 9-12	3, 5, 7, 9-12	2, 5, 7, 9-12
Number of selectable addresses	6	4	4	4	6	6	4
MIDI Synthesizer							
MIDI synthesizer chip	ICS GF1	Yamaha OPL3	Yamaha OPL3	Yamaha OPL3	Analog Devices ADSP 2115	Analog Devices ADSP 2115	Yamaha OPL3
Synthesizer type	Wavetable	FM	FM (wavetable option, \$169)	FM (wavetable option, \$169)	FM (wavetable option, \$59)	FM (wavetable option, \$59)	FM (wavetable option, \$249)
Number of operators for FM synthesis	N/A	4	4	4	2	2	4
Provides MIDI interface	■	■	■	■	■	■	■
Supports MIDI file recording/playback	■	■	■	■	■	■	■
Supports General MIDI standard	■	■	■	■	■	■	□
Number of MIDI instruments provided	192	175	113	113	128	128	None
Storage location	Software	Software	Software	Software	Software	Software	N/A
Mixing Capabilities							
Number of channels (recording, playback)	2, 32	6, 6	6, 6	7, 7	5, 5	5, 5	6, 10
Mixes audio from:							
CDs/Microphone	■	■	■	■	■	■	■
PC internal speaker/Stereo DAC	■	□	■	■	■	■	■
Stereo line in/Stereo synthesizer	■	■	■	■	■	■	■
Other	None	Optional 2-WAY adapter (\$195)	MIDI, WavSyn	MIDI, WavSyn	None	None	None
Ports							
CD-ROM	Optional (\$59)	■	□	Optional (\$49.95)	□	■	■
Drives supported	Mitsumi, Philips LMS, Sony	Any SCSI drive	N/A	Mitsumi, Panasonic, Sony	N/A	Any SCSI drive	Panasonic
Joystick/Speaker	■	■	■	■	■	■	■
Microphone/Headphones	■	■	■	■	■	■	■
RCA	□	□	□	□	□	□	□
Compatibility							
Ad Lib	■	■	■	■	■	■	■
Creative Labs Sound Blaster	■	■	■	■	■	■	■
Media Vision Pro AudioSpectrum	□	□	□	□	□	□	□
Microsoft Windows Sound System	□	■	■	■	■	■	■
Roland MPU-401	■	□	□	■	■	■	□
Compression Standard Support							
ADPCM	■	■	■	■	□	□	□
ALaw and Mu-Law	■	□	■	■	■	■	■
MPEG compression/decompression	■	□	□	□	□	□	□
Other	None	None	None	None	None	None	None
Technical Support							
800/Toll-free technical support	■	■	■	■	■	■	■
Technical support hours (eastern time)	11:00-7:30 M-F	11:00-8:00 M-F	10:00-9:00 M-F	10:00-9:00 M-F	8:00-6:00 M-F	8:00-6:00 M-F	9:00 A.M.- 11:00 P.M. 7 days a week
Warranty	3 years	1 year	1 year	1 year	3 years	3 years	1 year

N/A—Not applicable. The product does not have this feature. T1—Texas Instruments Inc.

CONTINUES

Creative Labs Sound Blaster 16 SCSI-2	Diamond SonicSound	Diamond SonicSound LX	Focus 2 the Max MusicMaker	Focus 2 the Max SoundMedia PRO
\$329.95 (with DSP)	\$299.00	\$149.00	\$169.00	\$199.00
44.1	44.1	44.1	44.1	44.1
Yamaha OPL3	Sierra Semi- conductors Ana T1	Oak Technologies Mozart	Oak Technologies Mozart	Analog Devices AD-1931B
Creative Labs		N/A	N/A	Analog Devices
4	4	4	4	4
2 5 7 10	2 3 5 7 10 12	2 3 5 7 10 11	5 7 10 11	5 7 10 11
4	4	2	4	4
Yamaha OPL3	Sierra Semi- conductors Ana Wavetable	Yamaha OPL3	Yamaha OPL3	Analog Devices AD SP2115
FM (wavetable option, \$249)		FM	FM	FM (wavetable option, \$30)
4	N/A	4	4	2
■	■	■	■	■
■ ■	■ ■	■ ■	■ ■	■ ■
□	■	□	□	■
None	175	None	None	128
N/A	Firmware	N/A	N/A	Firmware
8, 10	6, 6	6, 6	6, 6	4, 4
■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	□ □	□ □	□ □	□ □
■ ■	■ □	■ □	■ □	■ ■
None	None	None	None	None
■	■	■	■	■
Amy SCSI drive	Amy SCSI drive	Mitsumi, Panasonic, Sony	Mitsumi, Panasonic, Sony	Mitsumi Panasonic, Sony
■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■
□	□	□	□	□
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
□	□	□	□	□
■	■	■	■	■
□ □	□ □	□ □	□ □	□ □
None	None	None	None	None
■ □	■ □	■ □	■ □	■ □
9:00 A.M.~ 11:00 P.M. 7 days a week	9:00 A.M.~ 10:00 P.M. M-F, 11:00~7:00 Sat	9:00 A.M.~ 10:00 P.M. M-F 11:00~7:00 Sat	12:00~8:00 M-F	12:00~8:00 M-F
1 year	2 years	2 years	2 years	2 years

DSP chip. Its SCSI-2 interface supports a variety of CD-ROM drives. The SonicSound includes the same software as the SonicSound LX and adds Macromedia Action! 2.5 SE and Virgin/Trilobyte's 7th Guest.

A \$129 Professional Upgrade for the SonicSound provides additional MIDI patches and comes with a passable headset with microphone. Also included is SonicSound Listener software, which lets you operate Windows software by speaking common commands. In practice, the voice recognition proved more frustrating than convenient: Even after training, it was accurate about only two-thirds of the time in our testing. In one case, it even "recognized" a sneeze as a voice command.

A MIDI cable kit (which offers MIDI In and MIDI Out jacks) is a \$39.95 option for either product.

► **Diamond SonicSound.** List price: \$299; 1MB ROM upgrade with enhanced General MIDI, voice recognition software, and headset/microphone, \$129. **Diamond SonicSound LX.** List price: \$149. Diamond Computer Systems Inc., 1130 East Arques Ave., Sunnyvale, CA 94086; 408-736-2000; fax, 408-730-5750.

Circle 495 on reader service card

Focus Information Systems Inc.

Focus 2 the Max MusicMaker Focus 2 the Max SoundMedia PRO

BY TED NEEDLEMAN

Like many sound board vendors, Focus Information Systems offers both a low-end FM synthesis model and a high-end wavetable synthesis product. The Focus 2 the Max MusicMaker, manufactured by Oak Technology, is an entry-level card that lists for \$169. Almost identical to the

SUITABILITY TO TASK

Focus 2 the Max MusicMaker

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	●	○
Business audio	●	●	○	○
Games and education	●	●	●	●

HARDWARE

Sound Boards

► SUMMARY OF FEATURES



Products listed in alphabetical order

■ = YES □ = NO

	IBM Audiovation Adapter	IBM WinSurfer Communications Adapter	ImagiMedia Audio Image 16	Logitech SoundMan 16	Media Vision Pro Audio 16 Basic	Media Vision Pro Audio/Imedia 16	Microsoft Windows Sound System 2.0
List price	\$255.00	\$399.00	\$250.00	\$199.00	\$199.00	\$349.00	\$219.00
General Features							
Maximum sampling rate (kHz)	44.1	44.1	44.1	44.1	44.1	44.1	44.1
Sound chip set	IBM mVWSP 1020	IBM mVWSP 1020	Yamaha OPL2	Media Vision Spectrum	Media Vision Spectrum	Media Vision Spectrum	Analog Devices AD1848JP
On-board DSP manufacturer	IBM Electronics	IBM Electronics	N/A	N/A	N/A	N/A	N/A
Amplifier (watts per channel)	1	1	4	4	4	4	Info not available
IRQ levels supported	3, 4, 5, 7, 9, 15	3, 4, 7, 10, 11, 15	2, 5, 9, 10, 11	2, 3, 5, 7, 10-12, 15	2, 3, 4, 5, 6, 7, 10-12, 14, 15	2-7, 10-12, 14, 15	7, 9-11
Number of selectable addresses	4	4	4	3	7	7	4
MIDI Synthesizer							
MIDI synthesizer chip	IBM mVWSP 1020	IBM mVWSP 1020	Yamaha OPL2	Yamaha OPL3	Yamaha OPL3	Yamaha OPL3	Yamaha OPL3
Synthesizer type	Wavetable	Wavetable	FM, wavetable	FM	FM	FM	FM
Number of operators for FM synthesis	N/A	N/A	2	4	4	4	4
Provides MIDI interface	■	■	■	■	■	■	□
Supports MIDI file recording/playback	□□	□□	■	■	■	■	□■
Supports General MIDI standard	■	■	■	□	□	□	□
Number of MIDI instruments provided	128	128	128	None	None	None	None
Storage location	Firmware	Firmware	Firmware	N/A	N/A	N/A	N/A
Mixing Capabilities							
Number of channels (recording, playback)	2, 4	2, 4	6, 8	1, 2	2, 2	2, 2	2, 3
Mixes audio from:							
CDs/Microphone	■	■	■	■	■	■	■
PC internal speaker/Stereo DAC	□□	□□	□	■	■	■	□□
Stereo line in/Stereo synthesizer	■	■	■	■	■	■	■
Other	.WAV files	.WAV files	None	None	None	None	None
Ports							
CD-ROM	■	□	■	□	□	■	□
Drives supported	Panasonic, Sony	N/A	Mitsumi, Sony	N/A	N/A	Any SCSI drive	N/A
Joystick/Speaker	□■	□■	■	■	■	■	□■
Microphone/Headphones	■	■	■	■	■	■	■
RCA	□	□	□	□	□	□	□
Compatibility							
Ad Lib	■	■	■	■	■	■	■
Creative Labs Sound Blaster	■	■	■	■	■	■	■
Media Vision Pro AudioSpectrum	□	□	□	■	■	■	□
Microsoft Windows Sound System	□	□	■	□	□	□	■
Roland MPU-401	■	■	■	■	■	■	□
Compression Standard Support							
ADPCM	■	■	□	■	■	■	■
A-Law and Mu-Law	■	■	■	□	□	□	□
MPEG compression/decompression	□□	□□	□■	□□	□□	□□	□□
Other	None	None	None	None	None	None	TrueSpeech
Technical Support							
BBS/Toll-free technical support	□■	□■	□□	■□	■	■	□■
Technical support hours (eastern time)	9:00-9:00 7 days a week	9:00-9:00 7 days a week	11:00-8:00 M-F	11:00-8:00 M-Th 12:00-7:00 F-Sun	9:00 A.M.- 11:00 P.M. M-F, 11:00-7:00 Sat.-Sun.	9:00 A.M.- 11:00 P.M. M-F, 11:00-7:00 Sat.-Sun.	9:00-9:00 M-F
Warranty	1 year	1 year	2 years	3 years	3 years	3 years	2 years

N/A—Not applicable: The product does not have this feature.

ENDS



Multiwave Audiowave Platinum 16	Orchid SoundWave 32	Roland RAP-10	Toptek Golden Sound Pro 16	Turtle Beach MultiSound
\$299.00	\$299.00	\$599.00	\$199.00	\$399.00
44.1	44.1	44.1	48	44.1
Yamaha OPL3	Analog Devices ADSP2115	Roland Sound Canvas	Yamaha OPL3	E-Mu Proteus 1XR
N/A	Analog Devices	Roland	Toptek	Motorola
4	4	N/A	4	N/A
5, 7, 9-11	3-7, 9-11	5, 7, 8, 10, 11	5, 7-12	5, 7, 9-12, 15
7	2	8	4	8
Yamaha OPL3	Analog Devices ADSP2115	Roland Sound Canvas	Yamaha OPL3	E-Mu Proteus 1XR
FM (wavetable option, \$199)	FM, wavetable	Wavetable	FM (wavetable option, \$149)	Wavetable
4	2	N/A	4	N/A
■	■	■	■	■
■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■
128	128	128	None	128
Firmware	Firmware	Firmware	N/A	Firmware
8, 8	3, 4	18, 18	6, 6	2, 2
■ ■	■ ■	■ ■	■ ■	■ □
■ ■	■ ■	■ ■	■ ■	□ ■
■ ■	■ ■	■ ■	■ ■	■ ■
WAV files	None	None	MIDI	None
Optional (\$29)	■	□	■	□
Mitsumi, Panasonic, Sony	Mitsumi, Sony	N/A	Mitsumi, Panasonic, Sony	N/A
■ ■	■ ■	■ □	■ ■	■ □
■ ■	■ ■	■ ■	■ ■	□ ■
□	■	□	□	□
■	■	□	■	□
■	■	□	■	□
□	□	□	□	□
■	■	□	■	■
■	■	■	■	□
■	■	□	■	□
□ □	□ □	□ □	□ □	□ □
None	None	None	None	None
■ □	■ ■	■ □	■ ■	□ ■
12:30-9:30 P.M. M-F	10:00-8:00 M-F	11:30-8:00 M-F	11:30-9:00 M-F	9:00-6:00 M-F
1 year	2 years	1 year parts, 90 days labor	1 year	1 year

Diamond SonicSound LX also reviewed in this issue, right down to the bundled software, it lists for about \$20 more than the Diamond product but sells on the street for the same \$90 to \$100. The Focus 2 the Max SoundMedia PRO wavetable synthesis board is manufactured by Focus itself. At \$199 list and \$160 street, it's one of the least expensive wavetable synthesis cards you can buy.

Both cards come with interfaces for Mitsumi, Panasonic, or Sony CD-ROM drives; a MIDI/joystick port; and a selec-

SUITABILITY TO TASK

Focus 2 the Max SoundMedia PRO

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	●	○
Business audio	●	●	○	○
Games and education	●	●	●	○

tion of Windows- and DOS-based software to record and play MIDI and .WAV files as well as audio CDs. The absence of bundled voice recognition or text-to-speech software makes the boards somewhat unappealing for business audio applications, but they are well suited to educational and game-oriented use or even professional composition if CD-quality sound isn't an overriding concern.

Almost no background noise was audible when playing audio CDs or .WAV files, but our objective tests found that the MusicMaker showed limitations in high-quality audio, including poor bass response and a negative gain (which makes equalizing record levels from different sources a problem). The SoundMedia PRO demonstrated a low signal-to-noise ratio but didn't have a problem with negative gain.

Installing the MusicMaker was trivial: Its installation program walks you through setup and even tests the board to ensure that it's working. Setting up the SoundMedia PRO was initially troublesome, however. The user's guide we received is a tiny booklet—only 20 pages long—that starts off on the wrong foot with an erroneous description of how to install the software. (Focus says that new documentation will be shipping with the board by the time you read this.) We corrected the problem by running A:SETUP

from within Windows, and the card's default settings then worked fine.

The SoundMedia PRO uses an Analog Devices AD1848 DSP but doesn't provide any hardware compression capability. The card complies with the General MIDI standard and comes with a suite of software from Voyetra. Voyetra's documentation, unlike that of the card itself, is voluminous and well written.

The MusicMaker is a Yamaha OPL-3-compatible FM synthesis card based on Oak Technology's Mozart chip set. Its software bundle includes Macromedia's Action! 2.5 SE, Midisoft's Recording Session and Sound Impression, and a collection of DOS utilities that lets you record and play CD audio, .WAV, and MIDI files under DOS.

► **Focus 2 the Max MusicMaker.** List price: \$169. **Focus 2 the Max SoundMedia PRO.** List price: \$199. *512K wavetable upgrade*, \$39. Focus Information Systems Inc., 4046 Clipper Ct., Fremont, CA 94538; 800-925-2378, 510-657-2845; 510-657-4158.

Circle 496 on reader service card

IBM Personal Computer Co.

IBM Audiovation Adapter

IBM WindSurfer

Communications Adapter

BY STEVEN C. M. CHEN

The IBM Audiovation Adapter (\$255) and the IBM WindSurfer Communications Adapter (\$399) are both targeted at business users but in dramatically different ways. The Audiovation is a well-outfitted sound board with wavetable synthesis, a CD-ROM port, and an on-board DSP. The WindSurfer, also a wavetable synthesis board, uses its IBM Electronics DSP to double as a 14.4-kilobit-per-second modem (V.32bis and MNP 5-compatible), 9.6-Kbps send/receive fax, and digital answering machine.

We tested the ISA version of each product; MCA models are also available (Audiovation for \$300, WindSurfer for \$499). Street prices for the ISA version of the Audiovation typically average \$200; for the WindSurfer, about \$350.

In subjective tests, both boards pro-

SUITABILITY TO TASK

IBM Audiovation Adapter

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☐	☐
Business audio	☒	☒	☒	☐
Games and education	☒	☒	☐	☐

SUITABILITY TO TASK

IBM WindSurfer Communications Adapter

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☒	☐
Business audio	☒	☒	☒	☐
Games and education	☒	☒	☐	☐

duced clear sound, without breaks or hiss. The Audiovation showed excellent frequency response but also experienced high total harmonic distortion and intermodulation distortion. The WindSurfer also demonstrated superior frequency-response characteristics, and overall its objective audio quality was high; however, it had a negative gain and switched the left and right channels during digital playback. Power output for line-out signals on both boards is rated at a low 1 watt into a 4-ohm load, which means you'll want to use amplified speakers.

Setting up the WindSurfer can be an involved task because its communications functions can cause conflicts with existing COM ports in a machine. You must also run a supplied utility to activate the board's communication features. The Audiovation's setup was unremarkable.

The same Windows-based sound utilities, Mwave Recorder and Mwave Audio, are included for both boards. Some of the features mentioned in the Audiovation's documentation, however, were not actually implemented in its version of the software: Mwave Recorder lacked an audio signal strength meter, and the standalone Peak Meter utility was absent altogether. The included utilities are not as well integrated or as full-featured as the Voyetra utilities bundled with many boards; using them is a bit like using three different remote controls to operate your TV, VCR, and cable converter.

In addition to the usual array of audio jacks, the Audiovation includes two connectors for Panasonic or Sony CD-ROM drives. Two additional Windows applications are standard: Talk-to-Plus gives you voice control over Windows applications, and First Byte's Monologue converts text into speech.

The WindSurfer has two stereo line-in jacks and a pair of RJ-11 jacks for headphone hookups. The ISA version does not include a CD-ROM interface, although the MCA version (not tested) does. IBM PhoneFX, which allows you to set up a voice mail system on your desktop system, is bundled with the board, as is Trio Fax Lite software and a Prodigy membership kit.

► **IBM Audiovation Adapter.** List price: \$255; *MIDI kit*, \$90. **IBM WindSurfer Communications Adapter.** List price: \$399; *MIDI kit*, \$95. IBM Personal Computer Co., 3039 Cornwallis Rd., Dept. W32/B205, Research Triangle Park, NC 27709; 800-426-2968, 914-766-1900.

Circle 497 on reader service card

ImagiMedia Corp.

ImagiMedia Audio Image 16

BY JIM FORNEY

List priced at \$250 (often discounted to about \$199), the ImagiMedia Audio Image 16 is a combination FM and wavetable synthesis board based on the two-operator Yamaha OPL-2 FM and Dream France wavetable processors. Difficult installation, inadequate documentation, and poor sound quality make it difficult to recommend this product.

While the Audio Image 16 showed excellent frequency response, its signal-to-noise ratio, total harmonic distortion, and intermodulation distortion were poor. Our preamplifier tests showed considerable negative gain: To get adequate volume, most users will have to keep the

SUITABILITY TO TASK

ImagiMedia Audio Image 16

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☐	☐	☐
Business audio	☒	☐	☐	☐
Games and education	☒	☐	☐	☐

HARDWARE
Sound Boards

mixer utility's volume sliders at their maximum position, but this setting causes severe feedback.

Documentation was poor and contained several typos and other errors that will leave any inexperienced user in the dark. Software consists of ImagiMedia's proprietary mixer utility and 20/20 Sound Editor, its proprietary recording and .WAV file-editing program. The software installation routine crashed Windows several times, and the sound recorder screen froze during recording, showing a flat line instead of a waveform. We were able to play back our recordings, however. ImagiMedia's technical support was unable to solve our software and installation problems.

The Audio Image 16 comes with a connector for a Mitsumi or Sony CD-ROM drive; it is compatible with both the Creative Labs Sound Blaster standard and the Microsoft Windows Sound System. No hardware other than the board itself comes in the package.

► **ImagiMedia Audio Image 16.** List price: \$250. ImagiMedia Corp., 1991 Hartog

Dr., San Jose, CA 95131; 408-453-9911; fax, 408-453-9912.

Circle 498 on reader service card

Logitech Inc.

Logitech SoundMan 16

BY M. DAVID STONE

A low-priced package that is best suited for entry-level business and game applications, the \$199 Logitech SoundMan 16 (about \$110 street price) was one of the few cards we tested that installed without any problems and worked as promised.

The SoundMan 16 hardware consists solely of the sound card, a minimalist approach that carries over to the card itself. Built around the Media Vision Pro Audio Spectrum chip set, the card offers FM synthesis with four operators; it uses the Yamaha OPL-3 chip but lacks a CD-

ROM interface or anything as sophisticated as a DSP, wavetable in firmware, or hardware support for voice recognition. The one extra on the board is hardware support for ADPCM data compression—an important feature for business use.

The software is similarly lean. The DOS-level software is limited to a mixer and utilities for recording .WAV files and playing .WAV or PCM files. Windows software includes the widely used MCS MusicRack, which provides a mixer, MIDI player, CD player, and a digital

recorder, all of which use controls that will be familiar to anyone who has a tape recorder or CD player.

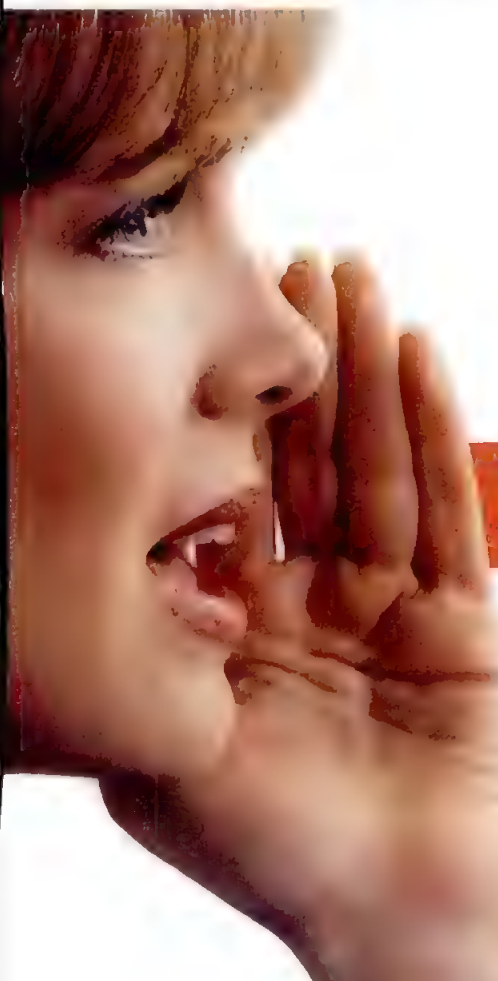
Also included with the SoundMan 16 are three some-

what whimsical utilities that let you add such options to Windows as animated wallpaper complete with sound. No business applications, such as a voice annotator, text-to-speech utility, or voice recog-

SUITABILITY TO TASK

Logitech SoundMan 16

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	○	○
Business audio	●	●	○	○
Games and education	●	●	●	○



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nition software, come with the package.

Performance on our listening tests ranged from a rich, full sound playing audio CDs to the familiar hollow sound of FM synthesis. On our objective tests, sound quality ranged from average to below average. Digital playback scores were about average, but bass frequency response, total harmonic distortion, intermodulation distortion, and signal-to-noise ratio figures were below average.

All told, the Logitech SoundMan 16 is best understood as a starter kit that has quality hardware and enough software to be useful. It's certain to leave gaps that you need to fill in. However, for a sound board, it's surprisingly easy to set up, and it's inexpensive enough so that buying additional software shouldn't break your budget.

► **Logitech SoundMan 16.** List price: \$199. MIDI adapter, \$49.95; CD-Audio cable, \$9.95 (available for most external CD-ROM drives). Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500; fax, 510-795-0335.

Circle 499 on reader service card

Media Vision Inc.

Media Vision Pro Audio 16 Basic Media Vision Pro AudioStudio 16

BY JOHN R. QUAIN

The \$199 Media Vision Pro Audio 16 Basic, which sells at a street price of between \$100 and \$120, is a good choice for game or entertainment use. The \$349 Media Vision Pro AudioStudio 16, which typically sells for around \$180, is bundled with additional features and software that make it appealing for business audio applications.

Both boards produced reasonably good sound quality, with no obvious background noise. Results from our objective tests ran the gamut, but the single most notable trend was diminished bass response from both boards. In

many of the tests, signal-to-noise ratio was also low.

An automated DOS installation utility makes installation easy enough, although it is still possible to run into conflicts in Windows. Media Vision does, however, allow you to change DMA and IRQ settings through Windows software.

The Pro Audio 16 Basic comes with all the necessary software for desk jockeys. It has DOS and Windows utilities, including Pocket Recorder, Pocket Mixer, Pro Mixer, and Pocket CD player. Pocket Recorder has only two compression schemes for 16-bit recordings (4:1 and 2:1), and the confusing Pro Mixer is in

SUITABILITY TO TASK

Media Vision Pro Audio 16 Basic

	POUR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	○	○
Business audio	●	●	○	○
Games and education	●	●	●	●

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HARDWARE

Sound Boards

need of an overhaul: It is still too easy, for example, to inadvertently generate howling feedback.

The Pro AudioStudio 16 comes with a more complete suite of audio utilities. In addition to all of the Pro Audio 16 Basic's applets, the Pro AudioStudio 16 has Media Vision's ExecuVoice voice recognition software, First Byte's Monologue for Windows text-to-speech program, as well as Midisoft's Recording Session for MIDI composers and Midisoft's Sound Impression for Windows.

All this software is flexible enough to meet most needs, although it has some drawbacks. Like other voice-command software bundled with sound boards, ExecuVoice uses a discrete speech-recognition engine. On our subjective tests, we found that it reacted too easily to unintentional commands and required more training time than some other

packages did in order to maintain an acceptable level of accuracy. Furthermore, Midisoft's Sound Impression, a stereo-system-like graphical interface for controlling different sound sources, worked reliably in our testing only with CD-ROM drives connected to the sound card's own SCSI controller. When we

tried to use Sound Impression to control an external drive running off of another SCSI card, the package behaved erratically.

Unlike the Pro AudioStudio 16, the Pro Audio 16

Basic doesn't have a SCSI controller. The Pro AudioStudio 16 also comes with a condenser microphone and headphones. Both boards have a joystick output that third-party adapters can convert into a MIDI output.

► **Media Vision Pro Audio 16 Basic.** List price: \$199. **Media Vision Pro AudioStudio 16.** List price: \$349. *For either*

board: External MIDI box and cable, \$69. Media Vision Inc., 47300 Bayside Pkwy., Fremont, CA 94538; 800-348-7116, 510-770-8600; fax, 510-770-8648.

Circle 500 on reader service card

Microsoft Corp.

Microsoft Windows Sound System 2.0

BY JOHN R. QUAIN

The hardware portion of the \$219 Microsoft Windows Sound System 2.0 will disappoint MIDI composers, game players, and those with internal CD-ROM drives, but tight software integration makes the Windows Sound System the best argument yet for business audio. An FM synthesis product, it's available from dealers for less than \$200.

The Windows Sound System's sound quality won't impress audiophiles: Total harmonic distortion was above normal, signal-to-noise ratio was undesirably low, and bass response was poor. Many of the

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HARDWARE

Sound Boards

SUITABILITY TO TASK				
Microsoft Windows Sound System 2.0				
	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	○	○	○
Business audio	●	●	●	●
Games and education	●	●	○	○

competing boards reviewed here provide more accurate sound reproduction. But for speech-driven business audio applications, the system's quality is certainly adequate.

Seven basic, easy-to-use applets are included with the sound board. They are also available separately for \$79 with the directional microphone. You can use the applets with an earlier version of the Windows Sound System or with compatible products from other vendors.

One of the bundled utilities, Quick Recorder, lets you make recordings at a variety of preset sampling rates and sizes—or choose your own custom parameters. You can then drag-and-drop

voice annotations or music clips into any OLE-compliant application and choose an icon to mark the annotation.

A significant addition to Quick Recorder is the software-based TrueSpeech codec (compression/decompression algorithm), which compresses voice recordings while maintaining maximum fidelity. During our subjective testing, we found that Microsoft's TrueSpeech spoken-word recordings sounded better than uncompressed 8-bit, 11-kHz recordings while requiring only one-tenth the disk space. The product also supports ADPCM compression.

Among other improvements in this version of the Windows Sound System is the revamped Voice Pilot voice recognition utility, which lets you issue voice commands to software. The new version requires less training time and lets you add words and different vocabularies more easily.

The board omits an internal analog audio connector, which means you can't play back audio from standard CDs or mixed-mode CD-ROM disks. No MIDI

or joystick connector is provided, either.

EDITORS' CHOICE ► **Microsoft Windows Sound System 2.0.** List price: \$219. Software and microphone, \$79. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 206-882-8080. Circle 501 on reader service card

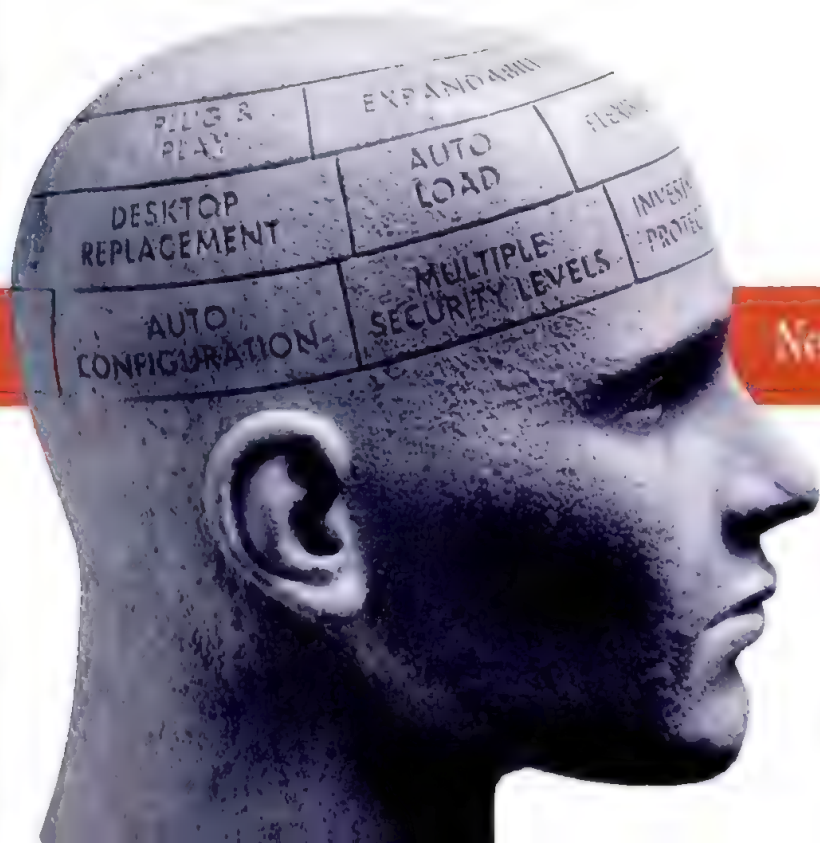
Multiwave Innovation Inc.

Multiwave Innovation Audiowave Platinum 16

BY STEPHEN W. PLAIN

The Multiwave Innovation Audiowave Platinum 16 board is a general-purpose sound card suitable for games, business applications, and desktop presentations. This FM synthesis board offers above-average sound quality with a broad upgrade path: Wavetable MIDI, three-dimensional sound, and a SCSI CD-ROM interface are all options. The board lists for \$299; discounted, it sells for about \$229.

The Audiowave Platinum 16 evidenced extremely low distortion and



New Intelligent Docking: So smart it



yielded an impressively high signal-to-noise ratio on most of our objective tests. Its preamplifier was nearly the equal of the Turtle Beach MultiSound, except for its poor treble frequency response. Also, we noticed some minor clicking during playback of CD audio in our subjective testing.

A videotape is included with the package in order to guide you through the installation procedure, but setting up the board turned out to be easy and uneventful. Everything worked for us on the first try.

Bundled with the board is Voyetra's Multimedia Toolkit, including AudioStation (a rack-mounted interface to .WAV, MIDI, CD audio, line-in, and mixer modules). Other bundled utilities include Say It (for annotating Windows documents with sound) and First Byte's Monologue for Windows.

The Audiowave Platinum 16 is based on a Yamaha OPL-3 sound chip; it is compatible with both the Creative Labs Sound Blaster standard and the Microsoft Windows Sound System. The board includes a connector for a \$199 wavetable synthesizer upgrade. The board's DSP can also be used to provide a three-

dimensional effect via Multiwave's 3D Space module (\$79).

The Multiwave Audiowave Platinum 16's built-in CD-ROM interface supports Mitsumi, Panasonic, and Sony drives, and you can

add SCSI CD-ROM support via a \$29 daughtercard.

► **Multiwave Audiowave Platinum 16.** List price: \$299; Wave FX module, \$199; SCSI daughtercard option, \$29; 3D Space module, \$79. Multiwave Innovation Inc., 747 Camden Ave., Suite D, Campbell, CA 95008; 408-379-2900; fax, 408-379-3292.

Circle 502 on reader service card

Orchid Technology

Orchid SoundWave 32

BY STEPHEN W. PLAIN

The Orchid SoundWave 32, from Orchid Technology, is a combination wavetable/FM synthesis sound card that is rich in features but still rough around the edges. The SoundWave 32 lists for \$299 and can be found at a discount for about \$220. It supports CD-ROM drives from Mitsumi and Sony.

Based on the Analog Devices ADSP 2115 digital signal processor, the SoundWave 32 provides broad compatibility and 1MB of built-in wavetable-based instrument sounds, ostensibly making it suitable for both multimedia presentations and games. The card's audio performance was poor, though; during testing, we noticed audible pops while electronically adjusting the volume. Our objective tests showed very low output levels and poor bass response. In Creative Labs Sound Blaster emulation, speech dropped out intermit-

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HARDWARE

Sound Boards

SUITABILITY TO TASK

Orchid SoundWave 32

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☐	☐
Business audio	☒	☒	☐	☐
Games and education	☒	☒	☐	☐

tently when we played Sierra On-Line's King's Quest VI—a problem the company says it has now corrected. Other games ran normally, and we encountered no problems under Windows.

We also ran into problems with inconsistent volume levels, a difficulty that was corrected by updated device-driver software that shipped during testing.

The card is bundled with Midisoft's Sound Impression, a "rack-mounted" multimedia control panel. It also comes with a simplified software mixer control. If you make the mistake of having Sound Impression and the mixer open simultaneously, you'll find that the two interfere with each other—a problem that was briefly troubling during installation. Otherwise,

installation proved straightforward.

Midisoft's Sound Impression, however, doesn't match the intuitive, elegant usability of Voyetra's AudioStation program, which is included with many competitors' boards. Macromedia Action! and Aristo-Soft's Wired for Sound Pro also ship with the SoundWave 32, as do a pair of small unamplified speakers and a clip-on microphone.

► **Orchid SoundWave 32.** List price: \$299. Orchid CDS-3110 CD-ROM drive, \$349; wavetable ROM upgrade (adds 80 instrument sounds), \$39.95. Orchid Technology, 45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0300; fax, 510-490-9312.

Circle 503 on reader service card

Roland Consumer Products Group

Roland RAP-10

BY HOWARD ALEXANDER

The Roland RAP-10 (RAP stands for Roland Audio Production) is the latest entry from a company long respected for

its professional MIDI keyboards. The board offers high-end performance, with a high-end price to match (\$599 list, about \$520 street). Like Turtle Beach's excellent MultiSound board, the RAP-10's performance and features are intended more for the professional than for the casual business audio user or game player.

SUITABILITY TO TASK

Roland RAP-10

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	☒	☒	☒	☒
Business audio	☒	☒	☐	☐
Games and education	☒	☒	☐	☐

The RAP-10 entirely omits a CD-ROM interface.

The RAP-10's sound quality didn't quite match that of the Turtle Beach MultiSound, but it was generally superior to the more mainstream boards we tested. Frequency response and channel separation were very good. Signal-to-noise ratio was high and distortion was minimal at maximum output levels, although at our



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midrange test levels the results were only average.

When playing back MIDI files, we were impressed by the realism of the sound, thanks largely to Roland's custom-wavetable-based Sound Canvas chip set and DSP. The board also supports special effects such as chorus, reverb, and delay in hardware. Our playback tests, however, uncovered unexpectedly high distortion levels in digital playback mode.

The RAP-10 offers a stereo microphone input that can be switched under software control to handle a second line-level source. The board doesn't provide a power amplifier on-board, so you'll either have to use powered speakers or hook the output to an audio amplifier of your own.

Installing the RAP-10 means setting jumpers for the board's one required IRQ and two required DMA channels. (The default settings worked in our test-bed system.) The installation software checks the system for resource conflicts but doesn't give you a list of available resources up front.

Roland includes Roland Audio Tools, a

version of Midisoft's Sound Impression software that's been specifically optimized for the RAP-10. Roland Audio Tools provides convenient controls and powerful editing functions with the familiar "rack-mounted" interface. The included WaMI Mixer software lets you mix and sequence .WAV and MIDI files, too.

► **Roland RAP-10.** List price: \$599. *MIDI connector box, \$120.* Roland Consumer Products Group, 7200 Dominion Circle, Los Angeles, CA 90040; 213-685-5141; fax, 213-726-8865.

Circle 504 on reader service card

Toptek Technology Inc.

Toptek Golden Sound Pro 16

BY M. DAVID STONE

The Toptek Golden Sound Pro 16 offers more features and more software than most FM synthesis sound cards do—especially considering its \$199 list price, which is often discounted to around \$150 or \$160. At first, all these considerations make the Golden Sound Pro 16 look like

SUITABILITY TO TASK				
	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	○	○	○
Business audio	●	●	○	○
Games and education	●	●	○	○

a good choice for games (it has Ad Lib and Creative Labs Sound Blaster compatibility) or business audio (it supports the Microsoft Windows Sound System and three forms of hardware compression). But despite the wealth of features, the package shows some major shortcomings.

For one thing, it doesn't sound very good. Background hiss was clearly audible, as was an occasional popping noise. The board's power amplifier was one of the worst we tested: Digital playback results were consistently below average and high distortion levels were evident in both the preamplifier and power amplifier stages.

Another problem: When we plugged a source into the board's line-in connector, it stopped sending MIDI output to the

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output port. When we used an external CD-ROM drive in our tests, we had to unplug the drive's audio cable to hear MIDI files, then plug it back in to hear CDs. Tiptek says the problem will be corrected by the time you read this.

The package stumbles on installation, too. The Golden Sound Pro 16 has a connector for Panasonic, Sony, or Mitumi CD-ROM drives, and its installation routine adds the appropriate drivers to AUTOEXEC.BAT and CONFIG.SYS. But in our test-bed machine, which already had a CD-ROM drive installed, the new drivers interfered with the existing drive.

Software is the board's strong point. Tiptek includes a complete set of its own DOS utilities, plus Voyetra's impressive AudioStation. Additionally, Windows applets for performing voice annotation in OLE-compliant applications are included, as are utilities to help compose presentations. The board supports ADPCM compression in hardware and A-Law and Mu-law compression in software. A stereo microphone is included in the package.

A \$39 upgrade provides surround-sound and echo effects using the board's proprietary DSP, and a \$149 daughter-card adds wavetable synthesis capability.

► **Tiptek Golden Sound Pro 16.** List price: \$199. Wavetable daughterboard, \$149; surround-sound kit to allow four-speaker output, \$39; MIDI kit (MIDI cable, two DB-15 game ports), \$45. Tiptek Technology Inc., 14140 Live Oak Ave., Unit C, Baldwin Park, CA 91706; 800-416-8889, 818-960-9211; fax, 818-960-0703.

Circle 505 on reader service card

Turtle Beach Systems

Turtle Beach MultiSound

BY HOWARD ALEXANDER

The Turtle Beach MultiSound board that won an Editors' Choice last year remains the benchmark against which other sound boards are compared. According to Turtle Beach, the MultiSound, which now has a list price of \$399 and a street price of around \$330, will be replaced by the MultiSound Monterey just as this issue is published. The Monterey, also \$399, builds on the features of the original MultiSound: It adds the ability to store

software wavetables and to expand on-board memory using standard SIMMs. The MultiSound Monterey was not yet in production as we went to press, so we have reported test results only for the basic MultiSound product.

The MultiSound's undisputed forte is professional-quality recording, playback, and MIDI composition. It is expensive for entertainment use, and its lack of a CD-

ROM port and standard microphone input (you must use an expensive line-level mike or your own mixer) make it inappropriate for many business applications.

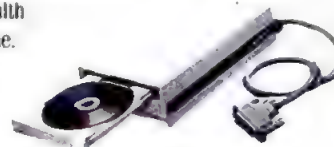
The MultiSound's audio quality is still the best around: Frequency response is ruler-flat, signal-to-noise ratio superbly high, and distortion is the lowest of any unit we tested. Audio connectors are plated in gold to prevent oxidation. Level controls



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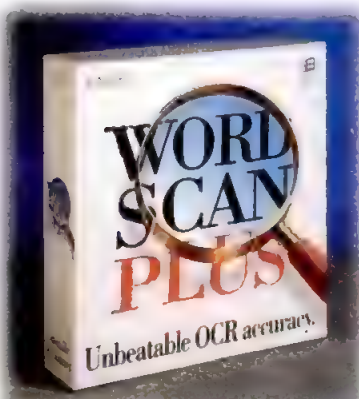
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HARDWARE Sound Boards

SUITABILITY TO TASK

Turtle Beach MultiSound

	POOR	FAIR	GOOD	EXCELLENT
Professional quality audio	●	●	●	●
Business audio	●	●	○	○
Games and education	●	●	○	○

provided much flexibility, with smooth volume control over their entire range.

The MultiSound uses the E-mu Proteus 1XR wavetable chip set preferred by professional musicians. With 4MB of stored instrument sounds, MIDI playback sounds realistic. Turtle Beach's proprietary Hurricane Architecture uses a high-speed on-board DSP to eliminate the need for a

The MultiSound's audio

quality is still the best around:

Frequency response is ruler-

flat, S/N ratio is superbly

high, and distortion is the

lowest of any unit we tested.

DMA channel and reduce CPU overhead.

Installation of the hardware was straightforward: We didn't encounter any problems or complications. Three switches on the board select the board's port address; all other hardware requirements are selected during the installation program. Our only complaint: The software doesn't actually tell you which system resources are available, an issue that Turtle Beach says will be resolved with the Monterey.

In addition to some MIDI tools and other accessory programs, Turtle Beach provides Wave Lite for Windows, a "lite" version of the company's excellent Wave for Windows editing program. Wave Lite provides basic sound-editing functions but offers no special effects or drag-and-drop capability. □

EDITORS' CHOICE ▶ **Turtle Beach MultiSound.** List price: \$399.

Turtle Beach Systems, 52 Grumbacher Rd., York, PA 17402; 800-645-5640, 717-767-0200; fax, 717-767-6033.

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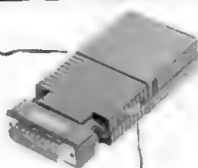
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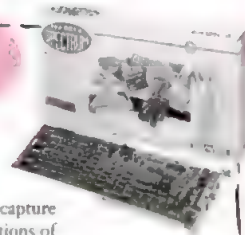
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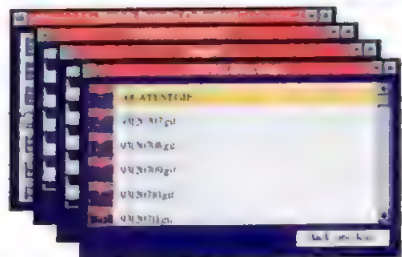
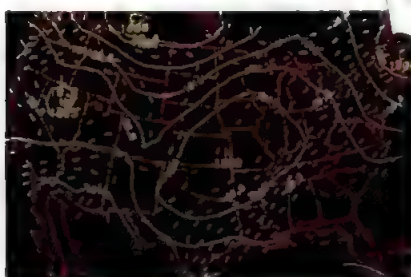
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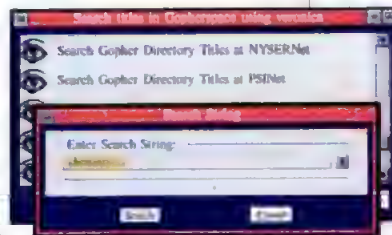


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WinGopher provides you with a graphical interface that uses pull-down menus and point-and-click functionality for easy Internet navigation. Using the Gopher

Requirements for Gopher Clients	WinGopher
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Supports Windows Sound and Video Viewers	✓
Supports Phone Books	✓
Enhanced Bookmarks	✓
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E-MAIL

Personae

As e-mail software matures, several distinct approaches are evolving—each reflecting the personality of the company that produced it. Which one is right for you?

Electronic mail is getting easier to use, easier to manage, and easier to travel with. Today you can cut the umbilical cord to your LAN and use e-mail on the road, via your laptop or portable.

As e-mail programs add features, each also grows into a mature part of a larger communications plan formulated by its parent company. Thus, e-mail packages take on some of the personality traits of their corporate creators, embodying the types of communications features those creators deem important for strategic survival.

Consider Microsoft Corp. This company of highly mobile, technologically sophisticated workers has developed the mobile e-mail program par excellence. For workgroups comprised of employees who constantly have to carry their work from office to home to plane—or anywhere there's a phone line—Microsoft's highly distributed mail system might be the most suitable.

Or perhaps your company is more like Lotus Development Corp., with its main campus in Cambridge, Massachusetts, its word processing division in Atlanta, and its e-mail division in Mountain View, California. It should come as no surprise that Lotus's cc:Mail excels at synchronizing mail databases long distance, across multiple

By Rick Ayre and Ted Stevenson

servers. If your organization resembles this multiple-site model, then cc:Mail may be the perfect e-mail program for you. It works for Lotus.

Or consider Beyond, a small company focused on a single product line. Beyond, with roots in MIT and the Information Lens research project, is interested above all in technical innovation designed to empower a self-motivated end user. BeyondMail is indeed a wonderfully innovative product that has changed the e-mail rules by inventing rules-based e-mail. If yours is a small company seeking to empower independent workers, this might be a natural fit.

Finally, take a look at On Technology, marketers of Notework Electronic Mail. They bought the package last year from its developers, largely because they used it and appreciated it as an example of the less-is-more principle, which they have always evangelized. If your company philosophy embraces a similar "just-what-you-need, just-where-you-need-it, just-in-time" approach, then Notework may be just the e-mail package for you.

As you look at the spectrum of e-mail software, one salient point emerges: When purchasing the software for your workgroup or even your whole company, you must seriously consider your organizational persona. Workers who are always on the road, innovators who have great customization needs, and network-administration gurus have differing priorities that should be taken into account. Furthermore, dedicating attention to how various e-mail products work will tell you a great deal about which one to buy.

EXPLOSIVE GROWTH

LAN-based e-mail continues to experience explosive growth. E-mail is the second most prevalent reason (after printer and file sharing) that people install LANs, and it's usually the first LAN-specific soft-

ware that's installed on a LAN. To help you find your best e-mail personality match, we review the latest versions of eight LAN-based e-mail packages: BeyondMail, cc:Mail, DaVinci eMail, Futurus Team Combo, Microsoft Mail for PC Networks, Notework Electronic Mail,

WinMail, and WordPerfect Office.

WinMail, a British import, is new to these pages, and WordPerfect Office we looked at briefly (as a DOS-only product) in our last e-mail roundup (*PC Magazine*, October 27, 1992). We reviewed the other six packages at that time. This year, we found that all have at least some improvements. And as we emphasized in our

1992 story, end users and administrators require different things from an e-mail package. Once again, we frame our story in terms of both agendas.

END USER NEWS: ALL GOOD

Good news abounds for end users contemplating any of these new and much-improved e-mail products. All handle a basic range of messaging tasks with aplomb; all have improved interfaces; a few actually have usable remote clients.

The "basic range" of messaging tasks has expanded beyond the bare send/receive store to include global message

searching, personal folders, return receipts, and automatic reply addressing. Most of these products do all these things well. And thanks to Windows (and its forebears), this growing functionality is easier than ever to harness: You'll find button bars and icons in all the interfaces, you'll be able to drag-and-drop in many, and you'll even find OLE and DDE support in some.

Our most-improved-interface award goes to cc:Mail for Windows. Lotus's new Windows client is impressively customizable: You can set up your own multiple SmartIcon toolbars, populating them with the tasks and functions you use most, ordering the icons as you like, and swapping toolbars at will. You can drag messages to your personal folders (which may be nested), the drafts folder for temporary storage, or the trash. To be fair, Microsoft Mail for PC Networks still has the best Windows interface, but cc:Mail has moved from a distant position to a close second.

But perhaps the best news is the remarkable improvement we found in remote e-mail offerings. All the remote programs we tested were at least usable, and the best, the Microsoft Mail for PC Networks remote client (new since our last roundup), was a joy to use. The brand new cc:Mail Mobile for Windows, with both an asynchronous option and an asynchronous wireless option, has moved light years ahead of cc:Mail's old DOS-only remote package—though it still falls short of Microsoft Mail for PC Networks' remote client.

ADMINISTRATOR NEWS: BETTER, BUT . . .

Considerably less progress has taken place in the administrator's domain. Only three

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 EDITORS' CHOICE

- **cc:Mail for Windows**

Competition in mature software markets is often a leap-frog affair. When we last reviewed LAN-based e-mail programs in these pages 18 months ago, we named the then-youthful Microsoft Mail for PC Networks, Version 3.0, our Editors' Choice, based on its nimble, friendly Windows

interface and the lightness of the burden it placed on administrators. Lotus's cc:Mail, which had not been upgraded for a considerable time, was given honorable mention. In the intervening period, Lotus has released a full-version upgrade of cc:Mail, and in doing so has gained ascendancy in the LAN-based e-mail market. cc:Mail for Windows, Version 2.0, is our Editors' Choice this time around.

cc:Mail's new Windows client front end has grown, both in depth of features and ease of use. Users now enjoy such amenities as nested storage folders and public bulletin boards. Rules-based end user programming now allows users to automate many aspects of the processing of their incoming mail.

Dozens of the client's functions and features have been pegged to SmartIcons, which users can assemble into customized toolbars. The extensive Preferences menu lets users further customize certain aspects of the interface. Users can, for example, indicate whether they want the package to spell-check messages automatically as they are composed.

cc:Mail's new remote client, cc:Mail

Mobile for Windows, goes far in remedying the deficiencies of the old remote package: A remote user can now review headers of unread messages and choose to download them or not—on a case-by-case basis. Users can also set up filters that weed out unwanted categories of messages altogether. A "docking" feature lets them link their traveling computers to their LAN-based accounts and download whatever part of their message stores they want to take on the road.

cc:Mail's back-end advantages are perhaps more decisive. The package provides a setup utility that easily extracts user information from NetWare's or VINES' user directory, vastly reducing the effort involved in establishing new post offices. Also, cc:Mail's single-database-file message-store structure minimizes disk-storage requirements and facilitates such crucial administrative chores as backup and message pruning.

Microsoft Mail for PC Networks, which placed first in last year's race, lagged slightly in this year's contest. The Windows interface remains attractive and accessible and offers a dazzling abundance of help and tutorial material. The package's greatest claim to fame

is its remote client—new since our last review. It looks nearly identical to the LAN-based Windows client and gives users virtually the same access to the contents of the message store. It's the strongest and most flexible remote we've seen; organizations with substantial remote-mail needs may be swayed by this alone.

Much of the remote client's success derives from Mail's basic architecture, which gives users the option to store mail on their local hard disks. Under this arrangement, the mobile computer becomes the traveling user's logical choice as the primary place to store messages. Unfortunately, decentralized message storage complicates such administrative chores as backup. Should users or administrators opt for server-based storage, much of the advantage of remote usage is lost, and another problem—dealing with enormous disk-storage requirements—arises. Furthermore, the administrator has no way of controlling the size of each client's server-based message store.

This year's impressive newcomer is the long-awaited WordPerfect Office, Version 4.0. It supports a wide variety of network operating systems and client front ends and promises impressive gateway connectivity to other mail systems. It offers a highly original Windows interface that serves as a command center for nonmail features (like scheduling and forms routing), as well as Norton Desktop-like customizability—all at a surprisingly modest price. Once its rough edges are smoothed, it will be a formidable contender indeed.

of our eight packages—cc:Mail, Netware, and WordPerfect Office—efficiently utilize user information stored in the NetWare Bindery or other network operating system when setting up post offices, for example. The rest of the packages range from stupidly flawed to highly quirky to mad-deningly manual.

As far as routine maintenance operations go, BeyondMail and WinMail offer simple hands-off automation—through

rules, in BeyondMail's case. Microsoft Mail for PC Networks provides automatic directory synchronization but—believe it or not—no way for the administrator to prune the mail of Windows-client users (who are enabled to store mail locally). cc:Mail's administration program allows batch automation of routine tasks, and special technology makes it possible to back up the mail store while users are active.

TOWARD A STANDARD?

Several of the programs we review require some form of Novell's Message Handling Service (MHS)—a specification we've always viewed as a mixed blessing. On the one hand, you can tightly link your e-mail program to NetWare using MHS. It also offers some theoretical compatibility among the programs that use it: Systems written to the MHS specification (Futurus Team Combo, for example, writes native-

HIGHLIGHTS

E-Mail Software

EVOLUTIONARY, not revolutionary, development characterizes the latest e-mail packages. Typical changes are more flexible use of folders, more widespread use of drag-and-drop in front ends, and—in back ends—easier post-office setup via extraction of user information from the network operating system.

FEATURES THAT HELP you manage and supercharge your messages abound. Rules support—in BeyondMail (as before) and cc:Mail (a new feature)—lets you manipulate your incoming and outgoing messages; you can send, store, and reply to any message that fits the rules you define. Routing features, too, have garnered attention: In Microsoft Mail for PC Networks, for example, you can define a sequential flow of your original message. After person A, it goes to person B, and after her input, to

person C, and so on. The postman keeps ringing.

SAY IT YOUR WAY with the help of newly implemented technologies. OLE support in cc:Mail, Microsoft Mail for PC Networks, and WordPerfect Office lets you grab any document, spreadsheet, or graphic—the range goes on—and insert it into your messages with all its formatting intact. See it your way too: Several packages include viewers, which let you grab a quick, easy look at any attached file. Microsoft Mail for PC Networks, Special Edition, and WordPerfect Office, for example, include the premier viewing utility, Systems Compatibility Corp.'s Outside-In. cc:Mail includes its own viewing feature. Look also for other kinds of add-on functionality—from Microsoft Mail for PC Networks' Schedule+ to Futurus Team Combo's PIM

features and WordPerfect Office's group scheduling, forms routing, and task management.

THE PROMISE and the pain of MHS, the "universal message transport," continue to run neck and neck. There's been a resurgence of interest in MHS among mail vendors, suggesting a ground swell of support for a standard. But Novell is now selling several flavors of the "standard," and implementation of MHS-based systems and modules is as quirky as ever.

A NEW WAVE of low-cost, Windows-based e-mail packages has come in. These programs serve smaller workgroups with tight budgets, offering simple installation and straightforward messaging features. We look at a sampling of such products in the sidebar "E-Mail: Lite and Easy."

ly to the MHS specification and does not require MHS) should be able to interoperate with each other by exchanging mail between servers without gateways.

But while Novell has improved MHS in innumerable ways since our last e-mail comparison, programs that use MHS remain more complicated to install and configure than those with proprietary message-transport systems. And since Novell has expanded the number of MHS flavors—you can now get NetWare MHS, Basic MHS, Remote MHS, and Global MHS—it's more difficult to know what to install.

Global MHS is Novell's new, optional, enterprise-wide mail engine. It supports multiple MHS-based front-end mail systems and X.400 mail transports, and it requires NetWare 4.0. Global MHS is clearly a high-end product that works by providing gateways, or switches, to X.400 as well as IBM SNADS and SMTP (Simple Mail Transfer Protocol)-based systems. At the moment, Global MHS is a

set of NLMs, but Novell has indicated that it may intend to make Global MHS a part of the basic network operating system. Basic MHS, also a set of NLMs, comes with NetWare 3.12. It serves as a platform for Novell's and other vendors' fax, e-mail, and work-flow software.

lines and boxes that forms require. Today, forms software is about routing and data collection, and the transport used—more often than not—is e-mail. Several of the packages reviewed here have extra-cost options for designing forms specific to their transport systems. BeyondMail's

\$495 forms designer is one example; the e-mail package even comes with sample forms. Also, users of Microsoft Mail for PC Networks can purchase Microsoft Electronic Forms Designer.

A second trend is group scheduling. Putting the computer to work finding group meeting times only makes sense, and piggybacking schedules on e-mail transport systems is a natural way to handle it. Meeting notification and participant confirmation are just two ways that e-mail and scheduling can interact to add value to both systems. Futurus Team Combo and WordPerfect Office both offer groupware facilities, and Schedule+ is an extra-cost option available to users of Microsoft Mail for PC Networks.

Good news abounds for end users contemplating any of these new e-mail products: All handle a basic range of messaging tasks with aplomb.

IS IT GROUPWARE YET?

Eighteen months ago, we expressed the view that e-mail was growing in ways that would transform it from the familiar into something quite different: groupware. No such clear-cut transformation has taken place, but it appears to be inching ever closer.

A couple distinct trends are emerging as e-mail evolves. One is forms routing. Electronic forms used to be drawing programs with tools geared to drawing the

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THE FUTURE HAS ARRIVED

Some of our past predictions have become present realities. Rules, for example, were too good an idea for Beyond to keep to itself. (Rules are customizable filters you set up to make your e-mail program work the way you want. You can, for example, have copies of all your e-mail forwarded to your assistant while you are on vacation.) BeyondMail was the first to offer rules, and it still offers the best, but all the big players now support at least some rules functionality. The latest versions of WordPerfect Office and cc:Mail come with solid rules

capabilities, and Microsoft Mail for PC Networks, Special Edition, includes WinRules—licensed from Beyond.

This is also the year of the mail-enabled application; the VIM (Vendor Independent Messaging) and MAPI (Microsoft Application Programming Interface) specifications are finally bearing fruit. For example, when you install Microsoft Office 4.0, it will detect if you are using a VIM- or MAPI-compliant system and install the correct drivers. Thereafter, sending documents from inside Excel or Microsoft Word is just a few mouse clicks away. Also, with

the upcoming MAPI 1.0 for Applications in Microsoft's Chicago—the new Windows—third-party vendors will be able to write front-end messaging clients and back-end service providers for use in MAPI-compliant mail systems. At press time, developers were planning to do both. How well they pull it off remains to be seen.

We've also been looking just over the horizon for signs of wireless communications dovetailing with e-mail, and it now looks as if 1994 will be the year that this happens in a big way. Links between e-mail and wireless pagers will also be on the way; these systems will alert recipients to the arrival of important e-mail wherever they are. Other users need to be able to access their mail even when phone lines are not immediately accessible. Wireless-modem vendors are happy to be of service, and today—for the first time—the software necessary to link wireless technology to e-mail is available.

Suitability to Task: E-Mail

Our Suitability to Task categories touch on a wide range of e-mail features, encompassing the perspectives of both the end user and the administrator.

Each product in this roundup offers DOS and Windows clients. Often the features of a given pair of clients might differ, either because their interfaces are not alike or because their releases are not equally up to date. Where the two clients were well matched, we rated the Windows client; otherwise we rated the client with the larger and richer feature set.

With the administrator's perspective in mind, we rated server installation and maintenance. With the end user's perspective in mind, we rated client installation, basic and advanced messaging, and the remote-access client

Mail server installation We rate the installation and setup of the back end of a package. For packages that require Novell's MHS, the rating takes into account the ease of MHS setup. Our installation involves setting up a single post office as well as multiple post-office environments, with each post office on a separate server; we also set up remote-client access stations. A high score means that a package provides for retrieval of user information from the network Bindery, customization of installation based on user lists and groups, and easy integration in a multiple-post-office environment. We also take into account whether components such as gateways are bundled free of charge.

Maintenance We rate general and specific administrative tasks. These include user-related tasks such as adding and propagating users and user groups on single post offices and across

SUITABILITY TO TASK		
	Product Name	
	POWER	EASE
Mail server installation	Poor	Excellent
Maintenance	Poor	Good
Client installation	Fair	Good
Basic messaging	Fair	Fair
Advanced messaging	Good	Fair
Remote	Excellent	Poor

multiple post offices, and tasks related to database pruning, file management, and backups. A top-rated package should offer easy-to-use and centralized administration utilities, as well as scheduling of directory synchronization, backups, and other tasks. We also look for packages that provide a high level of control of message routing among post offices.

Client installation We rate the process of installing the package on client machines.

Basic messaging We rate how easily a user can create, edit, send, and receive simple messages.

Advanced messaging We rate additional features, including a package's ability to use multiple fonts, paste graphics, and use DDE links and OLE objects. We also assess message-management features such as folders, rule-based management capabilities, and file viewers.

Remote We rate the setup, ease of use, and feature set available in a remote client. A high score means that the remote module offers most of the same capabilities as the LAN-based client, as well as conveniences specifically related to remote access, such as minimizing the time spent on-line.

AT WHAT PRICE?

The price of e-mail products is one dark spot on an otherwise bright landscape. Granted, these are high-end tools, but should we need a high-end accounting program just to figure out which is the best value (especially since the best value for a large installation may not be the best value for a small one)? For example, the programs reviewed here range from \$695 to \$1,300 for a 10-user setup. But a 100-user license costs \$8,500 for BeyondMail, \$7,000 for WordPerfect Office, and only \$3,295 for cc:Mail. These figures don't include added-cost options, some of which, like Microsoft Mail for PC Networks, Special Edition, you should not consider doing without.

Another consideration is technical support. Most packages reviewed here offer fax-back and CompuServe support, not to mention toll-free phone support and additional paid-support options.

When choosing an e-mail package in the face of so much complexity—pricing structures, endless add-ons, and the like—it's wise to keep in mind that all of these packages do the basic e-mail tasks. Once you understand the basic personality of your company—or workgroup—you'll be equipped to tackle the e-mail terrain. Remember, look for a package with the features you need and a personality that fits your organization.

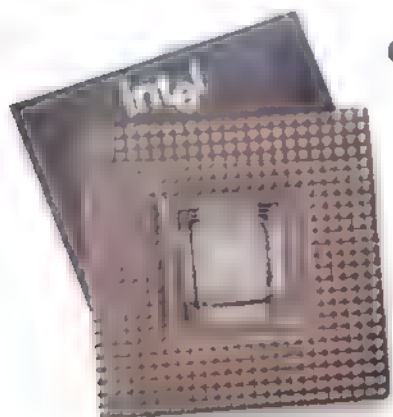
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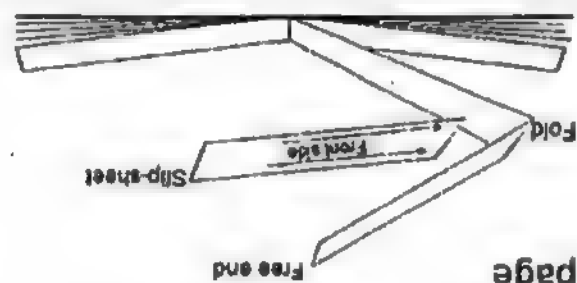
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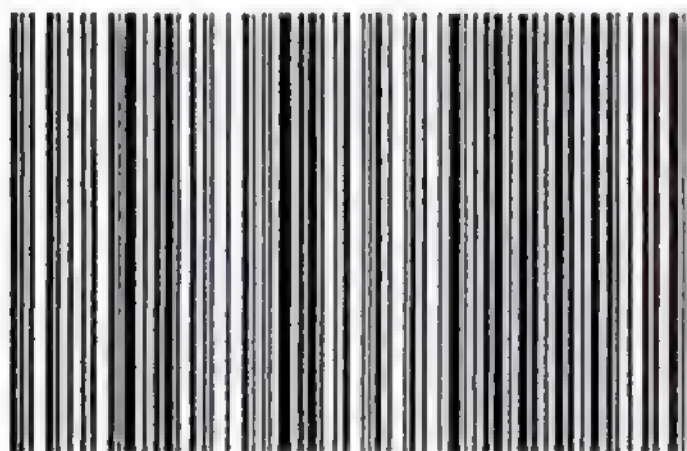
PC

Beyond the box.



1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

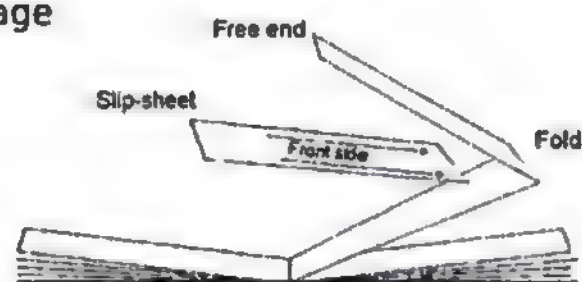


GbsSlipSheet-001

Folded edge of the page

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



GbsSlpBack-001B

Back

1. Follow instructions on the other side

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BeyondMail Inc.

BeyondMail for DOS BeyondMail for Windows

BY ALFRED POOR AND JOE SALEMI

BeyondMail for DOS and BeyondMail for Windows are very much alike in features and functionality, making it easy to create an e-mail system for both platforms on a single network. Priced at \$695 for a ten-user version, BeyondMail provides plenty of customizing features, powerful rule-based message handling that can automate complex tasks, and an excellent routing feature. On the other hand, BeyondMail requires Novell's MHS for multiserver environments and remote setup, making administration tasks more difficult than they are in some competing programs—especially when it comes to setting up remote access for users on the road.

ADMINISTRATION

BeyondMail requires Standard, Basic, or Global MHS, which has to be running on the server before the package can be installed. Both the DOS and Windows client applications and administration utilities are installed on the server through a Windows-based program. The installation program determines which MHS version you're using and automatically configures BeyondMail for it. It also assigns the appropriate rights for the BeyondMail directories to NetWare users. The administrator has to assign the directory rights on other LANs manually.

BeyondMail's reliance on MHS does add a level of complexity to setting up user mailboxes; if you're using Standard MHS, BeyondMail will automatically add e-mail users to MHS when you add their BeyondMail mailboxes. But if you're using Basic or Global MHS, you first have to add the user to MHS, specify BeyondMail as the

user's preferred application, and then create the user's BeyondMail mailbox. The Administration Guide contains details on running BeyondMail with different versions of MHS.

User mailboxes are primarily created and maintained through the Windows-based administration program and can be encrypted as an additional security measure. Users and user groups can be imported from the MHS user directory. Global and private mailing lists are created and maintained by running the BeyondMail Windows client program with the administrator command line option; any user can utilize this option.

BeyondMail comes with a new Windows 3.x administration utility that makes it easy to add and maintain users; the DOS command line utility has been upgraded. Like past versions, 2.0 relies on programs created in BeyondRules (its language for defining message-handling rules) for the bulk of its power, flexibility, and administration capabilities. With rules, the administrator can create a completely customized e-mail system. This ability, however, comes at a price. Administrators will find themselves spending a significant amount of time developing rules in order to tailor BeyondMail to their organizations' needs.

The mailboxes are maintained through the use of house rules that the administrator creates, which execute when a user runs the client application. House rules

can automatically purge messages over a certain age, clear out the user's Trash folder, and make backups of user messages. The administrator can set the house rules as read-only to prevent users from accidentally modifying them.

BeyondMail also supports cycle-once rules processing, which can be used to automate e-mail functions such as retrieving or forwarding mail, regardless of whether or not the user signs on to the e-mail system. Cycle-once rules are run by the administrator as needed; they can also be run on a continuous basis

FACT FILE

BeyondMail for DOS, Version 2.0

BeyondMail for Windows, Version 2.0

Beyond Inc., 17 New England Executive Park, Burlington, MA 01830; 617-229-0006; fax, 617-229-1114



List price: Ten users, \$695

Requires: 5MB hard disk space, Microsoft Windows 3.0 or later

MHS: The package is a native MHS application. It emulates MHS in single-server setups MHS 1.1 or later or Personal

MHS 1.1 or later is required for multiple-server environments and for remote connections

In short: BeyondMail for DOS and BeyondMail for Windows have some limitations in administration utilities and remote connections, but these factors are offset by the fact that the package is easy to learn and use. BeyondMail has flexible features, including rules, that can be used to automate complex procedures for individuals and organizations. Administrators even have access to cycle-once rules processing. Besides rules, a form-designer add-on lets users and administrators customize the package. The abilities to route messages and encrypt messages and attachments further enhance Beyond's power.



ON READER SERVICE CARD

SUITABILITY TO TASK

BeyondMail for DOS BeyondMail for Windows

	POWER	EASE
Mail server installation	Fair	Fair
Maintenance	Fair	Fair
Client installation	Fair	Good
Basic messaging	Fair	Good
Advanced messaging	Good	Good
Remote	Fair	Fair

through the use of a looping batch file. In the latter case, administrators must use a dedicated rules server. Otherwise, they can simply use the standard administration program. Rules can be created through the built-in rules editor or written with an external editor as ASCII text files and imported into BeyondMail.

BeyondMail is a powerful and flexible system that can fill most organizations' e-mail needs. Administrators can expect, however, to spend a lot of time getting BeyondMail functioning with MHS (particularly Global MHS) and developing rules to handle most administration functions.

END USER

The Windows client makes excellent use of the Windows interface and is very similar to the DOS client. Switching between the two clients takes little adjustment. Myriad configuration options—such as notification for new mail, font and margin settings, default tickler settings, and trash-handling

options—ease program customization.

Creating and answering messages, which are forms-based, is easy; you just fill in the blanks. The Beyond Forms Designer (\$495) allows custom forms to be sent via the e-mail program. You are not constrained to the standard mail-form layout, which is not the case with most of the other packages here. For a new message, you can use the address book to add names. A “type-down” feature quickly jumps you to the name you want, and you can add names to the To:, CC: (carbon

MailMinders. One of these will forward messages when you are scheduled to be out of the office.

BeyondMail has many other powerful features. One of the most sophisticated is the routing feature, which lets you define a sequence of recipients. You also specify the action that each recipient is to take: Approve, Comment, Edit/Approve, Modify, or View. You can track the status of a message with a tracking report that indicates the date and time each recipient receives and sends the message. Other attractive

features include robust message and attachment encryption.

Perhaps the weakest link in the program is the remote product (\$295). You must use Personal MHS on the remote computer, which acts as a remote message server and takes up more than 1MB of disk space. (The Windows client takes 10MB; the DOS client takes 7MB.) This means that the system administrator must configure the network to receive calls from (or place calls to) each remote system, and that each user who will be using a remote must also have a sepa-

rate mailing address on the remote server. Remote users then run a single-user version of BeyondMail on their remote systems. BeyondMail’s rules can help automate the forwarding of mail to remote servers when a person is away from the office, but there is still a significant amount of administrative work involved in setting up and maintaining this type of system.

Aside from its limitations regarding remote access, BeyondMail is a robust and versatile e-mail system that is easy to learn, powerful, and endlessly customizable.

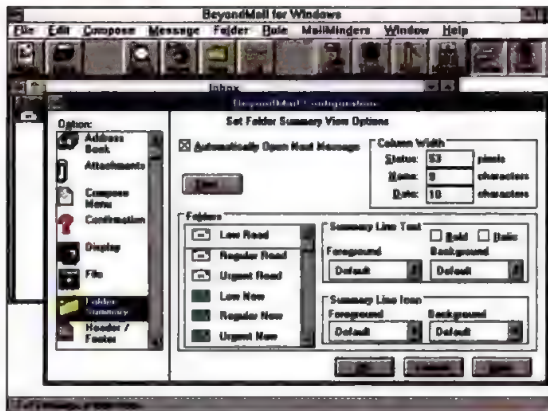
Lotus Development Corp.

cc:Mail for DOS

cc:Mail for Windows

BY CAROL ELLISON AND CRAIG ELLISON

Lotus Development Corp.’s cc:Mail is the longest-reigning market leader among LAN-based e-mail packages. Its



The configuration options in BeyondMail let each user tailor the program interface, as shown by these options for displaying messages in folders.

copy), and BCC: (blind carbon copy) fields using the same dialog box. A spell-checker lets you clean up your prose, and the Windows Clipboard can be used to copy information to and from Windows applications. The Windows version also supports DDE and OLE 1.0, but not OLE 2.0. When you reply to a received message, you have the choice of including the distribution list, the original message, or both. Incoming messages are signaled by a tone, and the Windows icon is animated to show the arrival of new mail.

Message management is straightforward: You store messages in folders, which are DOS directories. You can’t nest folders, but powerful search facilities let you search multiple folders in a single pass. You can also opt to store automatically copies of all messages sent, as well as archive messages to a text file.

Perhaps the program’s most important message-handling feature is its rule-based procedures. Users can define their own, using the rule language, but the program comes with some handy examples called

SUITABILITY TO TASK

cc:Mail for DOS
cc:Mail for Windows

	POWER	EASE
Mail server installation	Good	Good
Maintenance	Good	Good
Client installation	Good	Good
Basic messaging	Good	Good
Advanced messaging	Good	Fair
Remote	Fair	Fair

myriad platform packs can accommodate almost any corporate need, and its multitude of utilities and command options accommodate tight central administration. Also, it includes numerous mail options, from blind carbon copies to public bulletin boards.

cc:Mail supports clients in Windows, DOS, OS/2, Macintosh, and Unix; it also supports multiple gateways. At this writing, cc:Mail boasted a pay-as-you-go

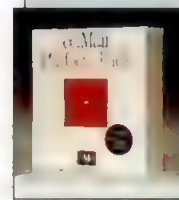
FACT FILE

EDITOR'S CHOICE

cc:Mail for DOS, Version 4.0

cc:Mail for Windows, Version 2.0

Lotus Development Corp., 800 El Camino Real West, Mountain View, CA 94040; 800-448-2500; fax, 415-960-0840



List price: Ten users, \$895

Requires: Server: 4MB hard disk space. DOS workstation: 400K RAM, DOS 3.1 or later. Windows workstation: 4MB RAM, 1MB hard disk space, Microsoft Windows 3.1 or later.

MHS: MHS is not required. The package supports MHS and includes an MHS gateway.

In short: cc:Mail, with its modular pricing and impressive support of multiple platforms, offers e-mail solutions for virtually any corporate environment. The package also supports a variety of gateways. It provides LAN users with strong central administration and messaging features. Rules support and SmartIcon customization let users establish personalized setups. Blind carbon copies and public bulletin boards are also advantages. Remote support, could be better, although the new cc:Mail Mobile for Windows sports a docking feature that moves cc:Mail’s remote capabilities in the right direction.

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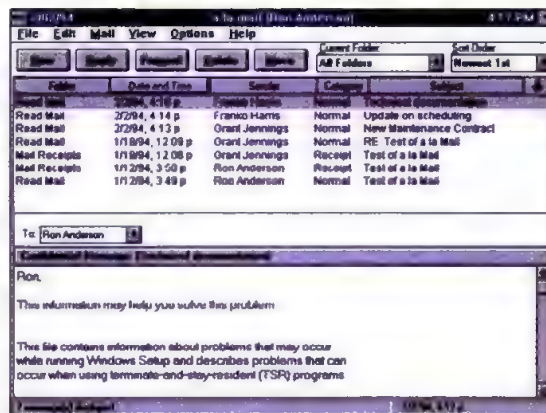
E-Mail: *Lite and Easy*

By Ron Anderson

Small-to-midsize businesses and workgroups rarely need all of the features offered (and concomitant administrative overhead created) by the industrial-strength e-mail packages reviewed here. If you don't need automatic directory synchronization among multiple post offices, an extensive choice of gateways to other e-mail systems, or support for cross-platform clients or MHS, there are a number of e-mail choices available that are reasonably full-featured yet easy to set up and run. *a la mail*, from *a la mode* workgroup systems (800-252-6633); *eNote*, from E Ware, a division of Visual Cybernetics Corp. (212-564-7791); and *NvMail*, from Image Machines Corp. (703-709-7475), are good examples of Windows-only packages that provide solid e-mail functionality with low overhead.

Each of these three packages features an easy-to-use interface, easy setup, and low implementation cost. *a la mail*, Version 1.1, costs \$595 per post office. By the time you read this, *a la mail* should be shipping in two flavors: The regular version will be \$99 per server (unlimited users), and *a la mail* Pro will include DDE support, a spell-checker, and a fax gateway (\$995, unlimited users). *eNote*, Version 2.0, will be offered at \$239 for 5 users, \$599 for 20 users, \$1,199 for 50 users, and \$1,899 for 100 users. *eNote* also has a

remote version available for \$99 and plans to be shipping *eNote* for *cc:Mail* (\$49) and *eNote Mobile* (\$99) by the time you read this. *eNote Mobile* will work with the RAM Mobile Data wireless network. *NvMail*, Version 2.0a, is priced at \$295 for a 10-user



The interface of *a la mail* has a text-oriented look that works well for detailed e-mail lists.

version and \$995 for an unlimited-user version.

DEDICATION UNNECESSARY

The three packages have a great deal in common. Not one, for example, requires a dedicated post-office machine, but they all do require either a shared directory on your network file server or a peer-to-peer directory to which each user has full access. All three have couldn't-be-easier Windows-based installation routines. In each case, after the program is installed, the mail administrator adds mail users one at a time through an

ADMINISTRATOR

A *cc:Mail* "platform package" contains the software necessary for establishing a post office, together with a copy of the client software. The initial installation process, which uses straightforward menus, sets up the post office and establishes one local user, the administrator. She or he then adds further users to the post office using "bump packs" in incre-

administration program. *NvMail* differentiates itself by including a utility to import users from the Novell Bindery—a nice addition that can save you tons of time. New groups are also created through the administration programs. You add members to groups by selecting them from the user list. Without exception, the installation and administration routines for these packages are simple.

Messaging is quite standard:

Each of the packages let you send mail and file attachments to individual or multiple recipients or groups. Addresses, carbon copies, and blind carbon copies are entered via pick lists (*a la mail* users can optionally enter addresses directly into a text box). Text is entered in the message body via the keyboard, by cutting and pasting from other applications, or by importing text files. *NvMail* includes a drawing facility that enables you to create line drawings and insert bitmapped files into messages; *eNote* provides a 100,000-word spell-checking dictionary. *NvMail* and *a la mail* can be run in standalone mode when you aren't connected to the network. When you reconnect, your mail is delivered automatically—a nice feature for laptop users.

NvMail's user interface, the most traditional of the group, is quite nicely designed. On start-up, you see a standard window with drop-down menus and a button bar; it displays one-line summaries of your messages. Icons to the left of each line identify the four types of messages supported: mail, voice, phone, and *Ez-Notes*. There is also a button on the button bar for

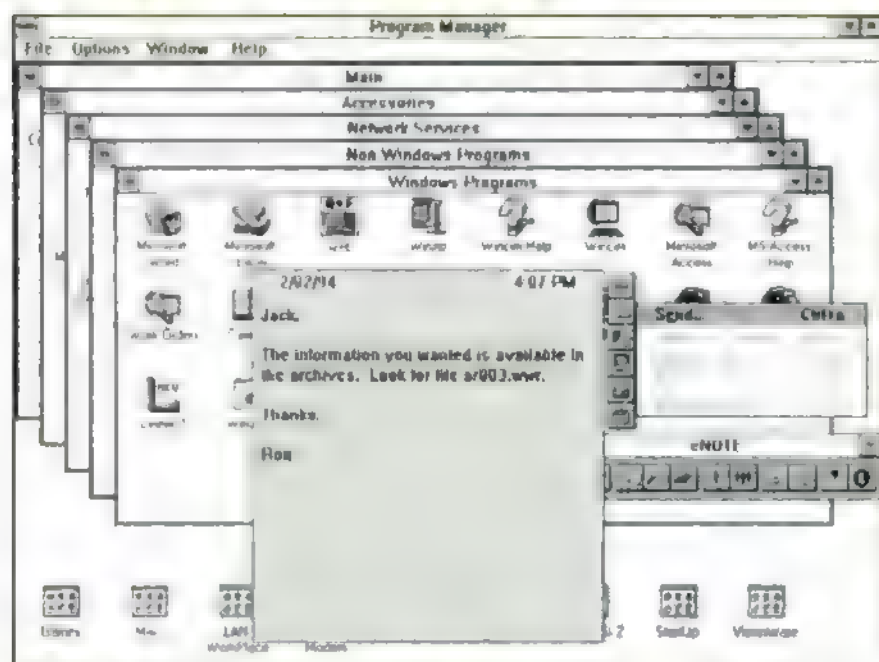
modular pricing scheme that could add up to a hefty bottom line, although that pricing scheme was under review during our review process. To quote just a few options, *cc:Mail*'s ten-user group pack with DOS and Windows clients and Lotus Organizer is priced at \$895; a ten-user bump pack is priced at \$345. Its new remote client, *cc:Mail Mobile* for Windows, is priced at \$195.

ments of 10, 25, or 100. The administrator may set up user defaults including preexpired passwords, minimum password lengths, and password-change intervals.

Directory-services programs for reading either the NetWare Bindery or the Banyan directory are included in the platform packs. These programs enter users directly into a post office, based on a con-

quickly creating each of these types of messages. If your system supports multimedia, you can record and play voice messages (see the sidebar "E-Mail Finds Its Voice" for details). Phone messages are electronic replicas of the ubiquitous, pink "while you were out" pads found in most offices. Ez-Notes are messages that can also contain bitmapped drawings and line drawings. Folders for organizing your

You won't find any icons with incomprehensible pictures on either screen, only labeled buttons. Message templates can be created from any mail that you compose. Templates can be private or public and serve as forms for standardized communications like travel requests. Message management is by means of folders; as with NvMail, drag-and-drop message movement between folders is not supported in Version 1.1.



eNote's interface represents the minimalist approach to e-mail.

mail are available only through the archive facility. NvMail would benefit from the addition of drag-and-drop message management.

a la mail's interface eschews a multitude of windows and icons, opting instead for a simpler approach—a read screen and a write screen, each divided into two parts. The read screen's upper section contains message-summary lines; the lower section displays the text of the summary highlighted above. The write screen's upper section contains addressing and mail-handling instructions; the lower section contains the message area.

figuration file defined by the administrator. This file lets you include or exclude groups or individual users, as well as enter users for remote post offices, making it easy to set up and initially synchronize post offices on multiple servers. A command line option reverses the NetWare Bindery's first-name/last-name format so that your mail directory will be sorted by last name first.

message, a blank area opens on your screen beside—you guessed it—another set of icons. "While you were out" forms are also included. eNote supports drag-and-drop message management and messages with sound.

If you're looking for refreshing, low-calorie alternatives to the rich, four-star, corporate e-mail heavyweights, *a la mail*, eNote, and NvMail are all worth exploring. While each offers a distinctive face and flavor, all three will capably handle all of your basic messaging needs—and be gentle on your pocketbook. □

cc:Mail's message store consists of a single encrypted-message "database" file along with an index file containing pointers that link users to messages in the database. Thus, a message sent to 50 addressees at a local post office is stored as a single message with 50 pointers. This architecture conserves network disk storage and facilitates regular backups; its disadvantage is that users who travel with lap-

tops do not have access to their accumulated message store. The new Windows mobile client partially addresses this problem by letting a user "dock" his LAN account to his mobile account while in the office and copy or move mail between the personal post office on the laptop and the server-based post office.

Directory and bulletin-board synchronization across post offices are handled by an optional program called ADE (Automatic Directory Exchange, priced at \$995 per post office). ADE allows a peer-to-peer or master/slave configuration for centralized administration, in which a hub post office can maintain users on any post office, local or remote. Mailing lists on remote clients, however, cannot be synchronized in the current release.

Mail is routed among post offices via cc:Mail's optional router, available in dedicated DOS-based and multitasking OS/2-based versions. When remote post offices are connected via the router, mail is exchanged, and if ADE is installed, directories are updated. In addition to asynchronous mapped drives and X.25 connections—which most mail systems support—the cc:Mail router also supports routing directly via SNA, SPP, SPX, and TCP/IP. On a WAN, these connections can significantly improve the speed at which messages are exchanged.

Most of cc:Mail's maintenance utilities are command line driven with multiple option switches. With them, administrators can create batch files to automate regular tasks such as reclaiming space from the central database.

Several activities can be automated and scheduled to run as a task using the task manager in the router program; one of the most important is the backup process. Since all mail is stored centrally, if even one user goes home with mail open, the critical index and mail database files will remain open and will get skipped by tape back-up systems. If you don't want to log your users off the network each night through the network operating system, cc:Mail provides a backup utility that will back up the critical files—even if they are open—to files that your tape system can save.

END USER

Client installation is easy: Users simply install the Windows client from the



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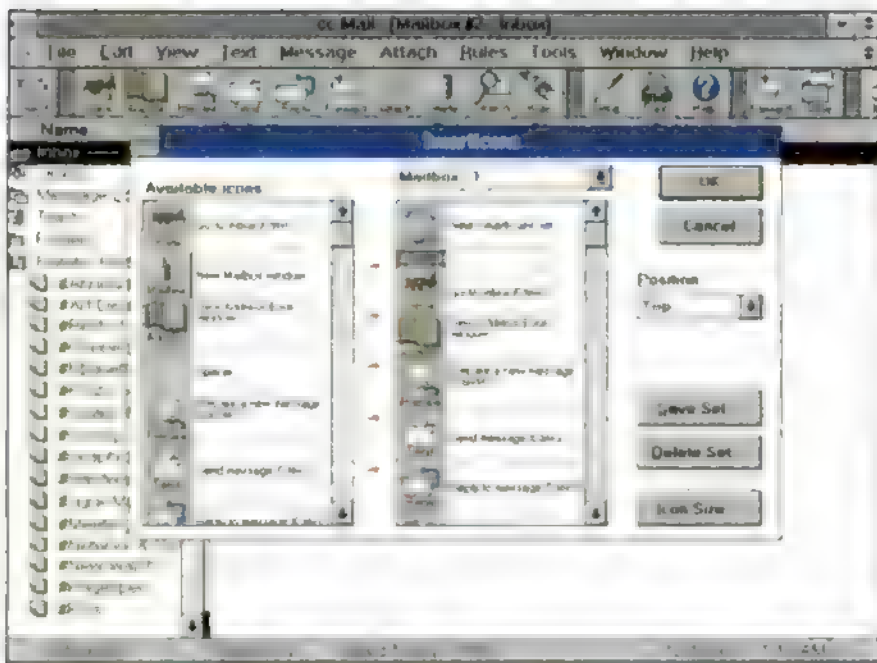
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In Touch with Tomorrow

TOSHIBA

CIRCLE 379 ON READER SERVICE CARD

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A setup display lets users customize cc:Mail's toolbar and add quick access to key features by simply clicking on the SmartIcons they wish to include.

File/Run menu or run the DOS client as an application directly from the server. Creating messages is also simple. You pick one or many addressees from the list of network users by typing the first few letters of the addressee's last name; cc:Mail's incremental lookup will find the names that match your input. You can also scroll through the lists. Addressees are identified by name, and aliases (nicknames) are supported. You can also set up private address books and distribution lists.

The Windows client offers a range of editing options. You can use several fonts and colored or highlighted text, and you can configure notification options—telling cc:Mail to play a tone, pop up a notification window, or both, for example—for when a message arrives. In both clients, you can specify urgent, normal, or low priority. DOS-client users can load a small TSR (1.5K to 16K, depending on whether EMS is present) to notify them of incoming messages; they can then hotkey into the mail client.

The Windows client interface is highly customizable, allowing you to set up your own SmartIcon toolbar with icons for the tasks and features you use most often. It also uses drag-and-drop for such tasks as attaching files and stowing messages in folders. You can create and rename your own folders. cc:Mail features Draft and Trash folders as defaults.

cc:Mail has no facility for routing mail sequentially among users, but in the Windows client, recipients can use the pack-

age's built-in rules to program cc:Mail to handle incoming and outgoing messages. You can, for example, have messages of a specified priority level forwarded to certain folders or to another user. You can also use rules to handle folder maintenance.

The Windows client features both multiple viewers and OLE 1.0 support, letting you click on attachment icons to view a fax, graphic, or document, or load a document directly into the application that created it. And it is quite attentive to security, letting you password-protect your mini-

mized mail icon. Powerful search features in both clients let you find and retrieve mail using 16 different criteria, such as the subject of the message or the day it was posted. The search feature also supports the logical operators AND and OR.

In addition to its many messaging features for private communications, cc:Mail offers public bulletin boards, where you can upload messages to all users on the LAN. BBS messages—in both clients—feature a security provision that lets only the creator of a message or the mail administrator delete them.

Users of the remote client can choose a DOS or Windows version, both of which function like their desktop counterparts; cc:Mail Mobile for Windows even includes the Windows client's rules feature. There's no BBS support in the remote client, though, and the only way of getting old messages is through the docking utility.

In sum, cc:Mail's impressive support of multiple platforms, its centrally stored and easily administered message base, and its many messaging options distinguish it among mail packages. These, and features such as blind carbon copies, return receipts, and bulletin boards make it an excellent electronic substitute for the paper trail.

DaVinci Systems Corp.

DaVinci eMail for DOS

DaVinci eMail for Windows

BY ALFRED POOR AND JOE SALEMI

The DOS and Windows versions of DaVinci eMail have been updated and synchronized to Version 2.05 (\$799 for a ten-user version), and while they might have been stand-out programs in our last roundup, this round shows them to have limitations that keep them from the ranks of the current competition.

ADMINISTRATION

Just the same, DaVinci is an MHS-based product that is capable and fairly powerful for NetWare users. DaVinci mailboxes support DOS and Windows clients equally well. Setup and administration have improved, though there are some

quirks in both that potential administrators should be aware of.

The ease of installing and administering DaVinci varies, depending on the version of MHS being used. Fortunately, the Administrator's Guide includes separate chapters for

each MHS version. Functionally equivalent DOS and Windows versions of the administration program are included. DaVinci has its own single-server version of MHS, called MHSLocal, which it automatically installs if it doesn't find a commercial version of MHS in the server directory that is specified during the installation process.

We tested DaVinci with Global MHS and found some quirks in how DaVinci synchronizes its own users with Global MHS users. Like BeyondMail, DaVinci requires the administrator to add users (manually) to the Global MHS directory first. Synchronization is then done through the administration program, which can be set to read the MHS user di-

SUITABILITY TO TASK

DaVinci eMail for DOS DaVinci eMail for Windows

	POWER	EASE
Mail server installation	Fair	Fair
Maintenance	Fair	Fair
Client installation	Fair	Good
Basic messaging	Fair	Good
Advanced messaging	Fair	Fair
Remote	Fair	Fair

Wilson just sent six e-mails

Faxed three purchase orders

Filed a detailed call report

Monitored today's receivables

And ran two credit checks

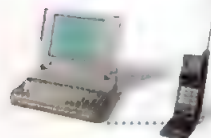
He should show up late for flights more often.



With Bell Atlantic® AirBridgeSM Data Services, you can use your office computers through your cellular phone. AirBridge gives you a reliable, affordable wireless link that makes it easy to send or receive data. It lets you fax, use e-mail, and access virtually any database from anywhere AirBridge service is available. Call



1-800-255-BELL. We'll tell you more about how AirBridge lets you take your office with you wherever you go.



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CIRCLE 342 ON READER SERVICE CARD

FACT FILE

DaVinci eMail for DOS, Version 2.05

DaVinci eMail for Windows, Version 2.05

DaVinci Systems Corp., P.O. Box 17449,
Raleigh, NC 27619-7449; 800-328-4624,
919-881-4320; fax, 919-787-3550



List price: Ten users, \$799.

Requires: Server: NetWare 2.x,
3.x, 4.x, or other file-sharing net-
work; 10MB hard disk space.
Workstation: 100K hard disk
space

MHS: The package is a native
MHS package and requires MHS for single-server envi-
ronments, although it ships with MHSLocal for those pur-
poses. MHS is required—and all versions of MHS are
supported—for multiple-server and external connections
In short: DaVinci eMail for DOS and DaVinci eMail for
Windows have not kept pace with developments in the
e-mail market. Administrators can use tools for creating
and maintaining workgroups and user mailboxes. The
“conversations” feature and public BBS support serve
as a couple of the package’s best usability traits. DaVin-
ci’s main weaknesses are limited message manage-
ment, awkward remote access, and a lack of support for
Windows features such as OLE and graphics support

444 ON READER SERVICE CARD

rectory automatically, either when the program is started or on demand. If the administrator sets DaVinci to treat all MHS users as DaVinci users—by specifying MHS as the preferred application in both systems—the synchronization process has to be run only when users are added to or deleted from MHS. If DaVinci is set as the preferred application (on a network with more than one e-mail package running, for example), the synchronization process reads the entire MHS directory. It will, however, display only the MHS users who have DaVinci specified but who aren’t already included in the DaVinci directory. This process can take a long time, especially if the MHS directory has more than 500 users.

The administration program is also used to create public and private mailing lists, create and maintain workgroups, maintain user mailboxes, set the screen colors for the DOS clients, and view the e-

Lotus Notes as E-Mail

By Ben Z. Gottesman

Lotus Notes, Version 3.0, is not an e-mail program, per se; it is, rather, a groupware tool that happens to include e-mail functionality among its several offerings. Here, we assess Notes’ e-mail prowess, but we also look beyond the traditional idea of e-mail to see how Notes might augment it.

To clearly understand Notes as an e-mail solution, one must first have a basic grasp of Notes concepts. Simply put, Notes is a flat-file document database. Notes *forms* are roughly equivalent to *records* in a standard database, showing one document at a time. Notes *views* are listings of documents. They can be used to summarize, organize, and filter the data in the database.

Notes uses a process called *replication* to distribute data throughout an organization. Replication places copies of a given database on different servers. Users can add, modify, and delete documents on whatever copy of the database is available to them. This, of course, means that the several copies of the database will become “unsynchronized.” So, periodically, the servers connect and replicate, exchanging altered information only, so that database contents are once again synchronized.

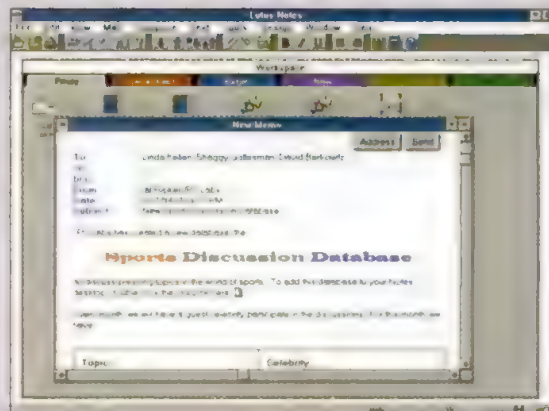
The Notes server software runs on an OS/2 or (with severely limited capacity) a Windows system. According to Lotus officials, a Notes NLM server for NetWare 3.x and later will be available around the time you read this. Client software is available in OS/2, Macintosh, and Windows versions, with a Unix version on the way; Notes lacks a DOS client. Notes supports AppleTalk, Banyan’s VINES,

IPX/SPX, and NetBIOS network protocols in the standard server pack. TCP/IP and X.25 support for OS/2 are also available at additional cost.

FLEXIBLE MESSAGING

NotesMail is a specialized Notes database that passes documents (messages) from specific senders’ out-boxes to specific recipients’ in-boxes. The mail interface in Notes, while spare in comparison with some dedicated mail packages, now utilizes both SmartIcons and a live status bar.

Messaging is form-based; users select one of five default forms—Memo, Memo to Manager, Phone Message, Reply, and Reply to All—and fill it in. The forms themselves are decidedly bare-bones, displaying not neatly delineated fields but merely



Although Lotus Notes has a somewhat inelegant design, it is unlike most other e-mail programs in that messages can contain rich text and graphics.

labeled pairs of brackets to show where address and message information are to be inserted—not particularly user-friendly.

Users can request confirmation that NotesMail messages have been received, opened, or both, and they can assign a category to the message for purposes of filing and organization (much like folders). NotesMail does not have any rules feature per se, but

advanced users can create macros to provide similar functionality. And BeyondMail, reviewed here, can work on top of Notes, enabling users to harness that e-mail package's rules functionality.

The body of a NotesMail message can contain graphics, OLE objects, and linked (attached) files, as well as virtually unlimited fonts. Notes' DocLinks feature links messages to documents in other databases. When the recipient clicks on a message containing a DocLink, the linked database is automatically opened and added to the user's desktop.

Users can sort their mail according to several default views, such as attachments, category, date, sender, and size. Sections within views can be expanded and collapsed; new messages are clearly indicated. As with any Notes database, users can easily create their own views, such as one that sorts by the Priority field.

Developers can also modify the standard mail forms or add their own. Lotus provides several sample forms, including forms called Employee Performance Evaluation, Reply with History, and Weekly Time Record.

DISCUSSION ALTERNATIVE

For group discussions, Notes uses Discussion databases instead of bulletin boards. It is easy to constrain who has access to Discussion databases, which is not the case with bulletin boards in most applications. The database template's standard forms and views make it easy to follow the dynamic of the conversation. A user starts a thread by creating the Main Topic form. Others reply using the Response form or Response to Response form. The default database view shows each topic and indicates the number of responses, indenting

those responses in an outline format. Discussion databases can be distributed to interested parties via a DocLink in a mail message.

For these reasons, as users become comfortable with Notes, Discussion databases will tend to take the place of

e-mail threads as we normally think of them. This benefits administrators too, since Discussion databases can result in a significant savings in disk storage. For example, a 20K mail message sent to 50 users will use up about a megabyte of server disk space; the same message in a discussion database only appears

once and will therefore take up 20K and no more.

THIS IS A SETUP

We tested Notes using OS/2 servers. Server installation and setup were relatively straightforward. (Be sure to follow the instructions in the Installation Guide and not the Administrator's Guide, which contains some procedural errors). The program cannot extract users from the NetWare Bindery, but you can import users from an ASCII-delimited file.

At the heart of Notes is a database known as the Public Name and Address Book, which contains—in addition to user names—information about groups, server connections, and the domain. One such book is maintained for every domain on a Notes network. Groups must be set up manually by the administrator, but they can contain users from multiple servers and domains. Individuals can also maintain their own lists of Notes users and private groups in their personal Name and Address books.

To set up additional servers on the same domain, as we did in our testing, you must first register the new server in the existing Name and Address book. Then you install the Notes software on

that server. Once you've set up a connection document in the Name and Address book to specify when databases should be replicated, the routing of mail among servers on the same domain is automatic. If you will be talking to servers that are not in the same domain, the connection document must contain information about frequency of mail routing as well.

Another Notes advantage is that it uses the same client software for remote users as it does for network-attached users. This makes for flexible, albeit rather slow, remote access. Remote users can work interactively, logging directly into databases on the server, or off-line, replicating server-based databases down to the workstation.

Modems for remote access can be hung directly off regular Notes servers, but if you expect a great deal of remote activity, you can create a dial-up server. Since users can access databases only on the server they call into, however, they must coordinate with administrators to ensure the availability of the databases they need to access.

As a traditional e-mail program, Notes is probably adequate for most organizations' needs—assuming that they have the not-inconsiderable hardware and personnel needed to support it and can afford the relatively high per-license price tag. Those who choose to bear the overhead, however, get a mail system with extensive built-in multiserver and wide-area connectivity, the unique advantages of the Notes discussion database, and a wealth of workgroup functionality we haven't even touched upon here. □

►FACT FILE

Lotus Notes, Version 3.0
Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142;
800-346-1305, 617-577-8500
List price: Per client, \$495; per server, \$495. Starter Pack for Windows, \$995 (includes two clients and a Windows server).

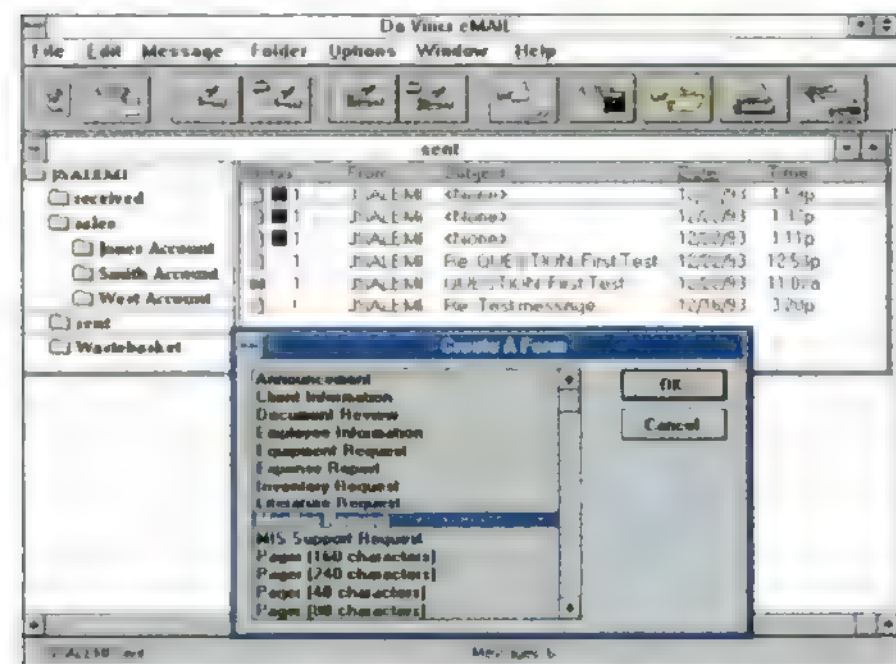
Circle 507 on reader service card

Notes is not an e-mail program, per se; it is, rather, a groupware tool that happens to offer e-mail functionality.

mail system log file. Public mailing lists and workgroups can be created only by the administrator. Through the administration program, users can purge and rebuild their mailboxes, set screen colors, and create private mailing lists.

DaVinci includes an electronic BBS that can be accessed by all DaVinci users and used for group round-table discus-

sions. The BBS is actually set up as an e-mail gateway; DaVinci users can read all the messages in the BBS system and can post messages to it by specifying BBS as the recipient. The BBS can be set up so that new topics can be started by any user, or only by the administrator.



DaVinci eMail's menus and buttons enable users to access major features—including predefined message forms—quickly and easily.

DaVinci is a capable and fairly powerful e-mail system that's primarily designed for use on a NetWare LAN. It will run with other LANs, but it's more complicated to set up. And besides, there isn't a Global MHS for non-NetWare LANs at this point. It's true that the public BBS capabilities are an advantage. But if you plan on using more than one e-mail package on your NetWare LAN, or if you don't run NetWare, you'd be better off looking at one of the other packages here.

END USER
The DOS-based installation of the DOS and Windows clients is simple. The administrator can choose to install only the DOS client, only the Windows client, or both. Both programs can be executed directly from a server directory. The administrator must add a Program Manager group and icon for the Windows client.

The Windows version has a clean, in-

tuitive interface with a toolbar of buttons for frequently used commands, a logical menu system, and balanced support for both the mouse and keyboard shortcuts for most operations. The DOS version of the program is text-based but also supports a mouse, and it relies on similar shortcut keys for many commands.

To create a message, you click on the Create button. The basic message form has fields for recipients, subject, attachments, and the body of the message. You can neither include graphics in the message nor use multiple fonts within the message text. Still, you can change the program configuration to use different fonts for different parts of the Windows screens. The package does come with many predefined forms that you can use as well. Examples of forms include Announcement, Document Review, Purchase Order, Resource Scheduler, Sticky Note, and Telephone Message.

While DaVinci does support To:, CC: (carbon copy), and BCC: (blind carbon copy) fields, you must go to three separate screens to select the names for each of the three categories. This makes the package less convenient than the programs that let you assign the recipient category on the same screen where you select the address.

DaVinci supports nested folders, but you are limited to searching the contents of one folder at a time. This is definitely a limitation if you aren't certain where you have filed the desired message.

On the other hand, the program's powerful "conversations" feature makes it easy to follow the thread of a sequence of messages. Any message that receives a reply or is forwarded is treated as part of a conversation. You can move back and forth among messages, making it easier to understand a message in the context of prior messages. Another feature of the message database is that each message is stored only once per user, even though you can save multiple copies of it in different folders. Of course, even though a message is stored only once per user, if you send it to 50 people, you still end up with 50 copies on your network.

The program does not have many other notable features. There is no OLE support, and DDE support is limited. There is an animated icon that notifies you of new mail within Windows, but this utility is separate from the main program. There is no feature for sequential routing.

The remote version of the program, \$299, relies on Novell's Personal MHS, which essentially turns the remote computer into a separate mail server. This can be an awkward arrangement, especially for someone who splits time between the office and the road. Each remote computer must be set up as a separate mail hub, and each address on it must be added to all host address lists. Since the program doesn't support rules, there is no easy way to make sure that messages sent to an individual will end up in the correct mailbox. For example, ideally, the user could define a rule that said, "If Name.OFFICE mail is not picked up within x hours, send to Name.LAPTOP" and automatically have the office mail forwarded to the user while on the road.

While there is nothing particularly wrong with DaVinci, it fails to deliver as rich and flexible a system as some of its peers manage to offer. It is weak in the message-management and remote-access arenas and could do more to take advantage of the graphical features of Windows. In sum, it needs another round of revisions to pull even with the current leaders.

Futurus Corp.

Futurus Team Combo

BY STEVEN C.M. CHEN AND LORI GRUNIN

Although Futurus Team Combo, Version 3.0, lacks the architectural elegance that we've come to associate with up-to-date software, the package serves as a solid MHS-based e-mail solution for small networks with modest traffic and minimal administrative needs. Priced at \$649 for a five-user version, Team drifts into groupware territory with its scheduling, notepad, phone-message-tracking, and card-file-database utilities, but it doesn't provide much automation when it comes to managing either your personal e-mail or an e-mail system.

SOFTWARE E-Mail

But two things make Team one of the more egalitarian packages here. First, the DOS client can run on 8088-based systems. And second, the administrator uses the same software as the end user; only network-based rights and password protection separate the two.

SUITABILITY TO TASK

Futurus Team Combo

	POWER	EASE
Mail server installation	Poor	Fair
Maintenance	Poor	Poor
Client installation	Fair	Good
Basic messaging	Fair	Good
Advanced messaging	Poor	Fair
Remote	Poor	Good

ADMINISTRATOR

Team's structure is fairly straightforward. Team keeps a central address book on the file server and moves messages and attachments around to the indicated locations—literally. If you send out a message to every user on your network, Team places a copy of the message in every user's mailbox.

Because of Team's simplicity, installation is relatively easy—albeit tediously manual. Team can read the NetWare Bindery to set up user names and groups, but only on the main file server. If you opt to specify addresses using mapped logical drive assignments instead of entering full pathnames, you need to press Enter three times for each user to accept the default values. This is time-consuming, but at least it prompts you as each user is added.

In a multiserver environment, which requires a \$695 option called Futurus Team WAN, Team routes all messages through a special user named FT on each server. You must enable Novell's Allow Unencrypted Password, though, which can create some security risks.

When adding new users using the DOS client, the administrator must type in the full volume and path of the location for each user (and MHS) directory if the system is to operate correctly. Alas, the software doesn't remember paths from entry to entry.

Moreover, Team does not provide any networkwide administration tools. For backup, the central mailbox files must be copied—manually—to each file server. Otherwise, if the master server is down, so is your e-mail. On the other hand, since the program is entirely location-based, it doesn't require a dedicated mail server, which makes it ideal for small offices with low-powered servers.

Team also lacks monitoring utilities. The program maintains logs only of remote log-on host operations. This may not be a problem if you have a network with light e-mail traffic, but keep in mind there's no easy way for an administrator to troubleshoot problems. Most important, there are no tools for globally deleting or archiving messages or setting individual users' space allotments.

Although the installation program is DOS-based, the administrator can perform maintenance under either DOS or Windows. The Windows User Group Maintenance (UGM) module, the only important administrative addition since the last time we looked at the product, has slightly more capability than its DOS counterpart. For instance, only in the Windows UGM can administrators change or update user passwords. With the DOS version, they have to delete the user and then add him or her back again (this process retains all the address information but restores the password to the system default).

END USER

Both the DOS and Windows clients have well-designed in-

FACT FILE

Futurus Team Combo, Version 3.0

Futurus Corp., 211 Perimeter Center Pkwy., #910, Atlanta GA 30346; 800-327-8296, 404-392-7979; fax, 404-392-9313

List price: Five users, \$649

Requires: No mail server is required. DOS-based network, LANtastic, NetWare, or any other NetBIOS network; 1MB hard disk space. DOS workstation: 640K RAM, DOS 3.1 or later. Windows

workstation: Microsoft Windows 3.0 or later

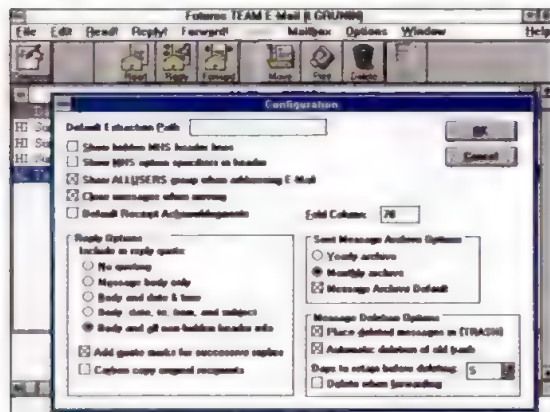
MHS: Futurus Team Combo is a native MHS application, but it does not require MHS

In short: A lack of automation and management tools makes Futurus Team Combo a poor choice for networks with large amounts of e-mail traffic. The Windows User Group Maintenance module provides some administration utilities, even above and beyond those of its DOS counterpart. For smaller sites, the product's basic and easy-to-use feature set, handy groupware utilities, and attractive pricing may compensate for the tedium of maintaining the system. Groupware features include a scheduling utility, a notepad feature, phone-message-tracking capabilities, and a card-file database.

445 ON READER SERVICE CARD

terfaces and relatively basic but slightly differing capabilities. For instance, the DOS client lets you insert files and tag multiple messages for printing or deletion, but the Windows client does not. But the Windows client has a spell-checker and supports user-selectable typeface and size for display. Both let you turn the notification capability on or off.

Team gives you pick lists for addressing, allows you to create personal address lists, supports blind carbon copies, and provides basic cut-and-paste capabilities in the message editor. Templates allow you to create boilerplate text that you can easily load into messages. You can even specify different receipt statuses for direct and carbon-copy recipients. You can also add attachments from a drop-down file list box. The package supports predefined sorts by date, sender, importance, and subject, and you can search for individual words across messages. There is no provision for creating rules.



Team offers a reasonable array of configurable default settings, including a broad selection of message-reply format options.

FOUR MILLION PEOPLE MAKE THAT FOUR



FRANK IS A COMPUTER BUFF. IN FACT, HE'S THE UNOFFICIAL cc:MAIL ADMINISTRATOR - WHICH TAKES HIM ALL OF 45 MINUTES A WEEK.

E-mail is not just for the big guys anymore. . . .

More and more workgroups and small companies are taking the step

to e-mail. Because now

there's the Lotus® cc:Mail®

Group Pack™ with everything

you need to get ten employees

up and running on the power

of cc:Mail.

cc:Mail lets you send

messages and files

electronically —

to colleagues,

clients, suppliers —

JOAN, THE V.P. OF FINANCE, COUNTS ON THE GROUP SCHEDULING FEATURE TO PULL MEETINGS TOGETHER EASILY.



BRIAN, IN QUALITY CONTROL, CREATES A WEEKLY STATUS REPORT IN LOTUS 1-2-3 AND USES cc:MAIL TO CIRCULATE IT THROUGH THE COMPANY.

speeding your processes and giving you an invaluable competitive tool. cc:Mail opens lines of communication, keeps everyone in the loop and eliminates all the running around.

Lotus cc:Mail, recently rated the #1 e-mail system by *Infoworld*†

and *Software Digest*†† offers

benefits no other e-mail can

match. Like a unique, rules-

based architecture which

lets you automatically

manage, filter, even

reroute your mail. And Lotus

Organizer™ 1.1, the top-rated

personal information

manager, is integrated

into cc:Mail Group Pack so you can schedule meetings quickly and easily. Just enter a suggested

time for a meeting

and Organizer

will consult

your co-

workers'

schedules

and tell you whether they're

available. And it does this

without revealing personal

schedules. Plus, cc:Mail has a

built-in spell checker, flexible

search options, an intuitive

user interface and dozens

of features that make it

easy to use.



BILL IN PRODUCTION USES cc:MAIL TO COMMUNICATE WITH HIS OUTSIDE SUPPLIERS.



SALLY, THE DESIGNER, HAS CUSTOMIZED HER MAILBOX TO PRIORITIZE HER INCOMING MAIL AUTOMATICALLY.

CURRENTLY USE cc:MAIL. MILLION AND TEN.

In fact, ccMail Group Pack is so easy to install, use and maintain that you don't need a dedicated LAN manager. And ccMail works across virtually all major hardware platforms, networks and operating systems. So it's easy to see why publications like *BYTE*, *LAN Magazine* and *Windows Magazine* have showered ccMail with awards. And why 4.2 million people in all kinds of companies depend on ccMail every day.

This standard is now

available for businesses, or work-groups, like yours. For about half of what these products would cost separately, you get a ccMail Group Pack

which includes: ccMail for Windows 2.0, ccMail for DOS, Organizer 1:1 and licenses for 10 users. All for just \$845 (SRP). (To add more users or to purchase additional copies of ccMail and/or Organizer see your Local Authorized Reseller.) At this price, it is not a question of whether or not your

company needs e-mail.

The question is: how quickly

can you get Lotus ccMail Group Pack.

Fortunately, it is available right now. Just visit your Lotus Authorized Reseller or call

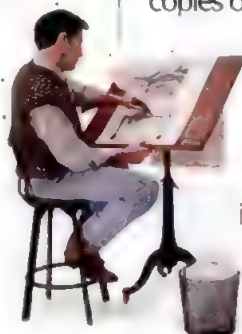
1-800-448-2500.



JIM, THE SUPPORT/DELIVERY GUY, USES ORGANIZER TO PLAN HIS DAY.



TED IS THE PRESIDENT OF A SMALL FURNITURE COMPANY. HE PURCHASED THE cc:MAIL GROUP PACK TO MAKE HIS COMPANY MORE COMPETITIVE.



JEFF, THE ART DIRECTOR, IS NO COMPUTER GENIUS. BUT HE GOT UP AND RUNNING ON cc:MAIL WITH NO TRAINING.



RHONDA IN SALES RECEIVES ORDERS FROM HER REGULAR CUSTOMERS VIA cc:MAIL.



SYLVIA IN ACCOUNTING LIKES EVERYTHING ABOUT cc:MAIL.

Lotus
Working Together

SOFTWARE
E-Mail

While you have a reasonable selection of options when replying to a message, forwarding messages is stickier; you can alter carbon-copy lists, but you can't annotate the message, change its priority, specify receipt status, or change the subject.

Similarly, Team gives you a limited set of message-management tools. Beyond deleting messages, you can create nonnested folders and move messages among them (via drag-and-drop in the Windows client). You can have Team save copies of messages sent in a monthly or yearly archive folder. The Windows client doesn't support OLE or DDE, however.

Team's groupware tools run under both DOS and Windows. The Phone Message Center acts as the electronic equivalent to a paper-based message pad. You can send, forward, and print messages as you would e-mail messages. The user can then selectively add callers to a frequent-caller database, which serves as a look-up table for future message entries. The scheduler, which allows

both group and personal entries, gives you daily, weekly, and monthly views as well as a task list; it will automatically send out e-mail notifications to meeting participants.

All users run the TSR-based DOS client from off the server. When dormant, it requires about 12K; when active, it requires about 128K. The TSR must be running under Windows for the Windows client (which runs locally but can be installed off the server) to operate.

A DOS-only remote client (\$149 per user; host software also costs \$149) consists of a utility for logging onto the dedicated host, tagging and downloading messages from the New folder, sending messages, and synchronizing schedule and database information, at up to 9,600 bits per second. Geared toward minimizing connect time, the remote program doesn't allow you to perform any message management. Once you've downloaded a message, either it's removed from your New folder—and thus becomes inaccessible for a duplicate download—or it remains there. You can't download mes-

sages from any other folders.

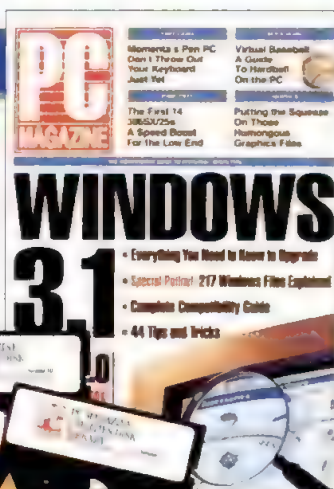
The utility works in conjunction with the standard client software. Setting up the remote host and client isn't hard, but the process would be simplified by the addition of a broader selection of branded modem initialization strings.

While the host software doesn't support BBS capabilities, Team does have a BBS-like "chat" facility. The group notepad can also suffice. Supplied in each Team client, it uses the metaphor of a stack of pages, with the first line of each displayed in a list. It also allows cross-page searching, as well as selective page encryption.

On a small network, the no-frills nature of Team and its concomitant ease of use may compensate for its lack of management tools. Similarly, the product has a mail-only brother, which lacks—among other things—a scheduler and phone-message support. Called Futurus Mail Plus, it comes in single- and five-user versions (\$39.95 and \$149.95, respectively). These are attractive low-cost options appropriate for smaller sites.

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Microsoft Corp.

Microsoft Mail for PC Networks

BY CRAIG ELLISON AND CAROL ELLISON

Microsoft Mail for PC Networks, which won an Editors' Choice in our 1992 roundup, is priced at a thrifty \$695 for a ten-user post office. Microsoft Mail for PC Networks, Special Edition (\$995 for a ten-user version), augments the basic package's many attractive messaging features with three third-party add-ins that work seamlessly with Mail. These include Beyond's WinRules, which lets users write rules; System Compatibility Software's Outside-In file viewer; and Management Software's Absentee Manager, which automatically forwards and sends messages when the user is away. Most offices will not want to be without these goodies.

SUITABILITY TO TASK

Microsoft Mail for PC Networks

	POWER	EASE
Mail server installation	Fair	Fair
Maintenance	Fair	Fair
Client installation	Good	Good
Basic messaging	Good	Good
Advanced messaging	Good	Good
Remote	Excellent	Excellent

Both the standard and Special Edition client packages include DOS and Windows versions—as well as OS/2 and Macintosh versions—in one box. The remote client is \$195.

ADMINISTRATOR

Microsoft provides samples of the files, drive mappings, log-on scripts, and security rights needed for installation under either LAN Manager or NetWare. The new utility that creates users from the NetWare Bindery (there's one for LAN Manager, too) extracts an editable file containing each user's log-on name and full name. Still, it makes no provision for including or excluding users or groups. Worse, the extract file retains the Bindery's first-name/last-name format, so that the resulting addressee list is sorted

by first name. If, like most organizations, your company wants its mailing list sorted by last name, you must manually edit the extract file before importing it or edit each user name with the administration program.

After setting up and populating a second test post office, we manually synchronized the two. Thereafter, Mail's automated global directory synchronization

scheme handled this task. The scheme produces the Global Address List (GAL). The task is kicked off when each requester post office sends its changes to the directory server at a single prearranged time each day.

Each client's mail gets stored in an individual encrypted and compressed .MMF file, which by default resides on the server. While this arrangement facilitates



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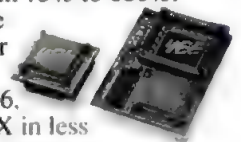


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CIRCLE 137 ON READER SERVICE CARD

E-Mail Finds Its Voice

By Hillary Rettig

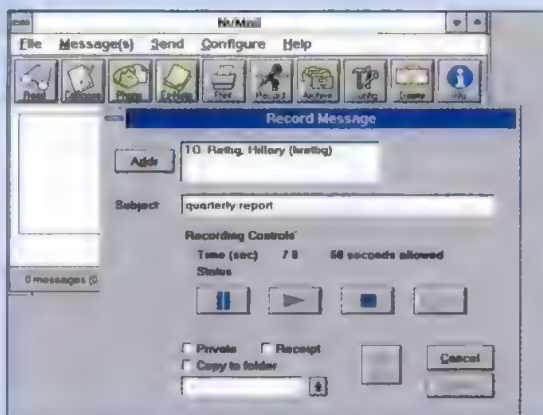
As hardware prices drop and sound technology improves apace, voice e-mail is becoming a realistic option for many networks. A good voice e-mail system marries the power and convenience of modern e-mail (which promises instant, effortless interchange of multiple messages) with the familiarity and immediacy of speech. This conjunction should certainly enhance productive communications in most organizations.

Voice e-mail today usually means a mail program that either allows recording, transmission, and playback of digital-sound files (usually .WAV files) or links a voice-recognition program like IBM's Personal Dictation System (which converts spoken input to text) to a LAN-based e-mail package (which transmits it). In the latter case, voice-recognition software converts spoken input to text, which is then transmitted across a network. The recipient then either views the text as is, or uses a text-to-speech program to convert it to machine speech.

Both methods have inherent advantages and disadvantages: The "record/play-back" method is technically straightforward and relatively inexpensive, but since sound files tend to be huge—as big as 10MB for a 1-minute recording—even moderate amounts of recorded voice e-mail can eat up lots of RAM and storage and choke even a high-bandwidth network. The voice-recognition strategy obviates these problems, since messages are transmitted as (usually small) text files, but it has myriad drawbacks. For example, voice-recognition systems have a rapacious appetite for RAM, and they demand high-end hardware. This can result in major expenses—often thousands of

dollars per user. Finally, these systems usually have some initial difficulty in correctly interpreting their masters' voices.

In this sidebar, we examine three packages that offer the "recorder" type of voice e-mail for a moderate cost. In each product, the voice facility acts as



NvMail offers one of the most attractive and easy-to-use interfaces of any popular e-mail package.

an adjunct to text-based e-mail. Since a given product's voice offerings usually won't be that much different from those of another product, users must also look at each package's interface and set of features. To get the most out of a voice e-mail system, you need a sound card and microphone on every computer on your network. Some of the programs reviewed here ship with drivers for motherboard speakers so that laptop users and others lacking sound cards can listen to—though not record—spoken messages.

None of the programs offer on-the-fly compression and decompression of sound files—a curious omission given the "fat file" problem. Nor do any of these voice e-mail packages offer encryption or security features other than password protection.

LANTASTIC FOR WINDOWS

With LANtastic for Windows, Version 5.0, voice e-mail capabilities have

been integrated directly into LANtastic, the best-selling peer-to-peer network operating system from Artisoft (602-670-7100; fax, 602-670-7101). Therefore, the package is convenient and the price (\$199) is right. Unfortunately, however, the product suffers from poor implementation and a dependence on proprietary technologies.

As a general e-mail package, LANtastic for Windows has clear limitations: It doesn't let you define e-mail groups or attach files to mail messages, for example, and it lacks sophisticated message-flagging and archiving. Furthermore, LANtastic for Windows' voice messaging relies on a proprietary sound-file format (MULAW) that is not a Windows standard; as a result, any files that you create will be limited to use within LANtastic for Windows.

On the plus side, LANtastic for Windows offers a "voice chat" feature that lets two or more users hold a quasi-real-time conversation. (In reality, speech is being recorded, transmitted, played, and deleted.) Artisoft is also the only company to offer DOS-based users access to voice e-mail; these users, however, must purchase Artisoft's proprietary sound card, Voice Adaptor, for \$99, which comes with a decidedly clumsy telephone-like handset.

M-MAIL

The first *M* in M-Mail (\$89 per node) stands for *multimedia*, and the program lives up to its name by allowing users to compose messages containing text, sound, graphics, and video. Among its serious voice-related features are the ability to access the recorder directly from the main program screen, a recording "pause" button (an enormous convenience), and the ability to send existing .WAV

files out as mail, rather than as attachments. M-Mail, Version 3.0, from InterActive Inc. (605-363-5117; fax, 605-363-5102), also lets you "package" voice e-mail with a speaker-activation program for automatic playback on PCs that lack sound cards.

M-Mail's standard e-mail features are, alas, only average, and we found its user interface curiously bland and nongraphical for a multimedia-oriented program. More important, perhaps, M-Mail is the only product reviewed here to use Novell's MHS as its transport mechanism. If you're not very familiar with MHS, you're going to find installing M-Mail a challenge.

NVMAIL

NvMail, Version 2.0, from Image Machines Corp. (703-709-7475; fax, 703-709-8966), costs \$495 for a 25-user version and is a polished, easy-to-install package with a nicely crafted user interface. NvMail stands out for its user interface, which, with its iconic toolbar, graphical mail indicators, and drag-and-drop file attachments, is the most polished of the voice-e-mail products reviewed here. Because of this interface, we found both installing and using the program to be a breeze, and many users should be able to get up to speed without referring to the manual. (See the sidebar "E-Mail: Lite and Easy" for more details on NvMail as an e-mail package.)

NvMail offers a couple of interesting enhancements to its basic record-and-play-back voice capability. It lets you associate .WAV files with specific events, so, for example, you can be alerted to incoming urgent messages. A handy configuration option lets the network administrator put a time limit on voice messages; this not only helps save disk space but probably aids workplace productivity by eliminating gabby messages. The program ships with a special speaker driver for PCs that do not have sound cards. □

regular backups, it also creates enormous demand for network storage capacity, since Mail copies messages to each recipient's private folder when he or she first opens a message. If, for example, you send a 20K message to 50 users, each user's .MMF file will grow by 20K when they read the message. If all 50 users have server-based storage, this message will consume 1MB of network disk space.

Users of the Windows client are also given the option of local storage. It's best for those who travel and retrieve mail remotely and use their notebooks full-time, as all of their mail will be with them on their notebooks. Local mail storage also reduces the need for network disk space. But that same architecture complicates central administration on the LAN: Adequate backups cannot be assured when Windows users store their .MMF files on their local hard disks, and in the event of a local hardware failure, users could lose all of their mail. Windows users can store (or "shadow") their messages on the LAN, but the proliferation of message copies can overburden network disk resources if users are errant in deleting old messages.

Remote users dial into a dedicated PC attached to the post office running the External program in the DOS-based Message Transport Agent (MTA). Administrators can limit the number of systems running External by concentrating remote clients on a few post offices, or by purchasing Microsoft's OS/2 MTA, which allows multiple sessions of External to be run on one PC. Remote clients can connect either via modem or via an X.25 connection.

Administration of local post offices is done through a single, menu-driven DOS-based program that provides reports on disk usage and facilities for deleting old mail and compressing folders and mailbags. Unlike cc:Mail, Mail allows file cleanup to be done while users are logged in. Still, Microsoft recommends that the compressing and deleting of files be carried out at "off-peak" usage times, and it doesn't provide a utility that determines active users or locks the post office during maintenance. So it's actually wise to compress and delete files when no one is accessing the mail system. Moreover, the maintenance utilities don't even operate on the .MMF files; the mail administrator must rely on individual users to keep their mailboxes clean.

FACT FILE

Microsoft Mail for PC Networks, Version 3.2

Microsoft Corp., One Microsoft Way,
Redmond WA 98052-6399; 800-426-9400,
206-882-8080; fax, 206-883-8101

List price: Ten users, \$695.

Requires: Server: 3.1MB hard disk space, Microsoft LAN Manager or NetWare 2.1 or later. Workstation: 2MB RAM, Microsoft Windows 3.0 or later

MHS: MHS is not required. The

package supports MHS, and an MHS gateway is available

In short: Microsoft Mail for PC Networks sports a unique, decentralized architecture that makes it an ideal product for offices with large outside sales forces. It works well for companies with multiple platforms to support; an automated global directory synchronization scheme helps keep updates coming. Generous on-line help and tutorials, a friendly interface, and OLE support make it especially attractive. Messaging features include creation, nesting, and sharing of folders; sequential routing of messages; and searching and sorting of messages. In Microsoft Mail for PC Networks, Special Edition, users can harness the power of three add-ons that offer rules, file-viewing, and automatic message-handling capabilities

 ON READER SERVICE CARD

END USER

Few other packages make e-mail so easy and accessible to the newcomer. Mail's on-line animated tutorials and copious help files will dispel e-mail mysteries. But Mail's interface is so clean and straightforward, and its messaging features so easy to access, the wealth of on-line help might be considered overkill.

Messaging couldn't be easier. A fixed toolbar and pull-down menu structure offer features for addressing and managing messages—even for changing your password. Mail provides several methods of addressing messages, including user-created distribution lists. You can even include non-LAN addresses, such as fax addresses, in your mailing lists. Forwarding messages is as easy as dragging and dropping them into the outbox; up pops the addressing form to fill in. Mail makes only a single font available for message text. But it does support OLE, so you can insert fully formatted documents and



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► SUMMARY OF FEATURES

CONTINUES

E-Mail

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Products listed in alphabetical order

■ = YES □ = NO

Pricing

	BeyondMail for DOS, BeyondMail for Windows	cc:Mail for DOS, cc:Mail for Windows	DaVinci eMail for DOS, DaVinci eMail for Windows	Futurus Team Combo	Microsoft Mail for PC Networks	Network Electronic Mail	WinMail	WordPerfect Office
List price	\$695	\$895	\$799	\$649	\$695	\$595	\$595	\$495
Number of users	10	10	10	5	10	10	10	5
Remote module	\$295 (DOS or Windows version)	\$295 (DOS or Windows version)	\$299 (DOS/ Windows package)	\$149 (DOS or Windows version)	\$195 (DOS or Windows version)	\$149 (DOS or Windows version)	\$295 (DOS or Windows version)	Included

SYSTEM ADMINISTRATOR FEATURES

General Features

Floppy disks included	3.5"	3.5", 5.25"	3.5", 5.25"	3.5"	3.5", 5.25"	3.5"	3.5", 5.25"	3.5"
Mouse support	■	■	■	■ (Windows version only)	■	■ (Windows version only)	■	■
Mailboxes can reside on local disks	■	□	■	□	■	□	□	■
Reads NetWare Bindery	■	■	■	■	■	■	■	■
Runs with NetBIOS LANs	■	■	■	■	■	□	■	■
E-mail log-on separate from network log-on	■	■	■	■	■	■	□	■
Notifies user of incoming mail	■	■	■	■	■	■	■	■
TSR notifier	■	■	■	■	■	■	■ (Windows version only)	■
User can disable notification	■	■	■	■	■	■	■	■

Message Management

Administrator can:

Read all messages	□	□	□	■	□	■	□	□
Change user passwords	□	■	■	■	■	□	□	■
Use default user profile	■	■	■	■	■	□	■	□
Delete outdated mail	■	■	■	□	■	■	■	■
Limit space in old mail files	■	□	■	□	□	□	□	■
Set up subject bulletin boards	■	■	■	■	□	□	■	■ (public mailboxes)
Manage multiple post offices centrally	■	■	■	N/A ①	□	□	■	■
Manage system via dial-up log-on	□	■	■	■	■	□	■	■
System can reclaim space automatically	■	□	■	□	■ (Windows version only)	□	■	■

Security

User can arrange for assistant to pick up recipient's messages	■	□	■	■ (DOS version only)	■ (Special Edition only)	□	■	■
User can arrange for private messages only recipient can read	■	□	■	□	□	□	■	■
Messages can be password-protected	■	□	■	□	□	□	□	□
Message encryption	User-defined	Built-in	User-defined	None	Built-in	None	User-defined	Built-in

Gateways

MHS:								
Native MHS application	■	□	■	■	□	■	■	□
MHS support	N/A ②	■	N/A ②	N/A ②	■	N/A ②	N/A ②	■
MHS gateway	N/A ②	■	N/A ②	N/A ②	Optional	N/A ②	N/A ②	Optional
Separate gateways for:								
AT&T Mail	Optional	Optional	Optional	Optional	■	Optional	Optional	□
CompuServe	□	Optional	Optional	Optional	Optional	□	Optional	□
DEC All-in-One	Optional	Optional	Optional	Optional	Optional	□	Optional	Optional
DEC VMS Mail	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional
IBM DISOSS	Optional	Optional	Optional	Optional	Optional	□	Optional	Optional
IBM PROFS	Optional	Optional	Optional	Optional	Optional	□	Optional	Optional
MCI Mail	Optional	Optional	Optional	Optional	Optional	Optional	Optional	□
Wang Mailway	Optional	Optional	Optional	Optional	Optional	□	Optional	□
X.400	Optional	Optional	Optional	Optional	Optional	□	Optional	Optional
User can mix local and foreign addresses in the same message	■	■	■	■	■	□	■	■

Other Compatible Platforms

Macintosh workstations	□	■	■	□	■	□	□	■
OS/2 workstations	□	■	□	□	■	□	□	□
Unix workstations	□	■	□	□	□	□	□	■
VAX workstations	□	■	□	□	□	□	□	□

Modules

Remote module for logging on via modem	Optional	Optional	■	Optional	■	■	Optional	■
Remote interface matches client interface	■	■	■	■	■	■ (DOS version only)	■	■

N/A ①—Not applicable: The product does not have this feature. N/A ②—Not applicable: The product writes directly to the MHS specification

SUMMARY OF FEATURES

ENDS

PC MAGAZINE
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Products listed in alphabetical order

■ = YES □ = NO

Modules (continued)

	BeyondMail for DOS, BeyondMail for Windows	cc:Mail for DOS, cc:Mail for Windows	DeVinci eMail for DOS, DeVinci eMail for Windows	Futurus Team Combo	Microsoft Mail for PC Networks	Network Electronic Mail	WinMail	WordPerfect Office
Selective download	■	□	□	■	■	■	■	■
User can maintain copies on server	■	■	■	■	■	■	■	■
Fax module	Optional	Optional	■	Optional	Optional	Optional	■	■ (outbound only)
Viewer for incoming faxes	□	■	■	■	■	Optional	■	□
Product Support								
Demo disk available	■	■	■	■	■	■	■	■
Unlimited free telephone and fax support	■	□	■	■	□	■	■	■
Toll-free support	■	□	□	□	■	■	□	□
Additional support available for a cost	■	■	■	□	■	□	■	□

END USER FEATURES**Editing Functions**

	64K	20K	64K	22K	Limited only by disk space	10K	32K	32K
Maximum size of buffer	64K	20K	64K	22K	Limited only by disk space	10K	32K	32K
User can move blocks	■	■	■	■	■	■	■	■
User can import ASCII files	■	■	■	■ (DOS version only)	■	■	■	■
Includes graphics editor	□	□	□	□	■	□	□	□
Includes text editor	■	■	■	□	■	■	■	■
Shows boldface text	■	■	■	N/A ①	□	□	□	■
Shows underlined text	■	□	■	N/A ①	□	□	□	■
Spell-checker	■	■	■	■ (Windows version only)	■	□	□	■

Attaching Binary Files

	64K	20K	64K	22K	Limited only by disk space	10K	32K	32K
User can view directory tree	■	■	■	■	■	■ (Windows version only)	■	■
Point-and-shoot file selection	■	■	■	■ (Windows version only)	■	■ (Windows version only)	■	■
Maximum number/size of attachments	62/unlimited	20/unlimited	Unlimited/ unlimited	64/64MB	Unlimited/ unlimited	64/unlimited	64/unlimited	Unlimited/ unlimited
User can encrypt attachments	■	N/A ①	■	□	□	□	■	N/A ①
User can save received attachments to disk	■	■	■	■	■	□	■	■
User can insert objects into message	■	□	□	□	■	□	□	■

Addressing, Organizing, Searching

	64K	20K	64K	22K	Limited only by disk space	10K	32K	32K
User can select addressees from directory	■	■	■	■	■	□	■	■
Directory shows location or department	■	■	■	□	■	■	■	■
User can create and edit mailing lists	■	■	■	■	■	■	■	■
User can select files with cursor	■	■	■	■	■	■	■	■
User can assign priorities	■	■	■	■	■	■	■	■
User can store and sort received mail	■	■	■	■	■	■	■	■
User can establish message threads linked by date, recipient, or topic	■	■	■	□	■	□	■	□
User can set up topic folders	■	■	■	■	■	■	■	■
Folders may be nested	□	□	■	□	■	□	□	■
User can search all received mail by date, message text, sender, or topic	■	■	■	■ (DOS version only)	■	□	■	■
Other	Field, form type	Carbon copy, priority, read/ unread, receipt returned, send date, send time, size	Address, attachments, blind carbon copy, encryption, priority	Keyword	Recipient	Keyword	Attachments, attachment content, date range, priority, subject	Attachments, priority, read/unread

	64K	20K	64K	22K	Limited only by disk space	10K	32K	32K
End-user programming via "rules"	■	■	□	□	■ (Special Edition only)	□	■	■
Messages can be routed sequentially	■	□	□	□	■	□	□	■
Message forms available	■	□	■	□	■	■	□	■
Documentation and Help								
Summary cards	■	■	■	□	□	■	■	■
Tutorial	□	□	■	□	■	□	■	■
Index in user manual	■	■	■	■	■	■	■	■
On-screen diagrams or examples	■	□	■	□	■	□	■	■
Context-sensitive help	■	■	■	□	■	□	■	■
Pop-up help windows	■	■	■	■	■	■	■	■

N/A ①—Not applicable: The product does not have this feature. N/A ②—Not applicable: The product writes directly to the MHS specification.

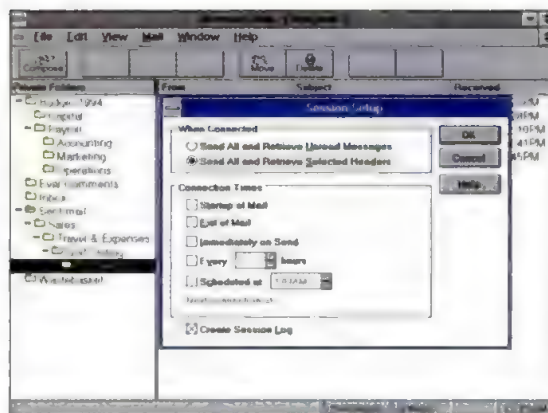
SOFTWARE E-Mail

spreadsheets (entire files or partial selections), as well as charts, graphs, drawings, and bitmaps, into the message text as objects, with formatting intact.

Schedule+ and Microsoft Electronic Forms Designer are a couple of extra applications users can purchase for enhancing their messaging capabilities.

You can set up the spell-checker to run automatically any time you send mail, or you can run it at will. Mail also supports an unlimited number of attachments to any message and will load attachments into their native applications when the recipient double-clicks the attachment icon. Users can set notification options for receipt of mail and assign priorities—urgent, normal, or low—to mail they send. The package has no provision, however, for blind copies. And although users can send mail to distribution groups on other post offices, there is no way to identify the individual members of those groups.

Users can create and nest folders. The



Remote users of Mail can choose to send mail and retrieve only headers or messages of previously selected headers.

package's powerful search engine, Message Finder, searches across folders, retrieving messages based on words or text strings either in header fields or in the message text. From within any folder, too, you can click on the category headings and Mail will sort messages by priority, time received, or alphabetically by sender. Special Edition users may specify conditions and special handling using the

rules-writing menus in WinRules and the automatic messaging features in Absentee Manager.

Mail's answer to public bulletin boards (like cc:Mail's) is shared folders. Users can set these up, and users with rights to the directory where the folder is stored may access its contents.

Message routing, another handy Mail feature, sends a message to a user-specified sequence of recipients, allowing them to append their own remarks as the message travels its route. Windows-based applications that support MAPI automatically detect Mail's presence as they are installed and offer a routing option on their File menus. This lets you send documents and spreadsheets along with message text directly from the applications. Mail tracks the documents being routed, and if you've sent the document before, it tells you so.

The excellent remote client allows efficient use of on-line time and great flexibility when working off-line. Users may opt to download just the message headers,

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examine them off-line, and reconnect to download only the messages they want, thus minimizing connect time. Each time a remote user connects after directory synchronization has taken place among post offices, his or her remote address list is automatically updated.

Mail shines with its strong remote capabilities and useful add-ons. Its distributed storage scheme best suits environments that have little need for centralized administration but can take advantage of the package's remote and messaging flexibility.

On Technology

Notework Electronic Mail

BY DAVID HARVEY AND RICH SANTALES

A definitively simple and easy-to-use package, Notework Electronic Mail (\$595 for a ten-user version) best suits users with basic e-mail needs. You can get a server full of users up, running, administered, and trained in this native MHS

application in less than half an hour. But many important e-mail features—such as advanced security, configurable folders, and OLE and DDE support—are missing. Sophisticated administration features—such as the ability to define users' disk space limits—are also left by the roadside.

Since our last roundup, Notework has been acquired by On Technology and has matured into Version 3.0, which includes a real Windows interface (earlier versions relied on a work-around of DOS designed to run in a window) and better folder support; that's about all.

ADMINISTRATOR

Setting up Notework is a snap: Simply create a directory, copy the Notework

files, and run the DOS-based installation utility. Notework's Install application reads the NetWare Bindery and presents you with a list of users and groups. You scroll through the list selecting the users you want on Notework mail; a counter keeps you posted on the number of remaining licenses. Beware, however: You

can install more users than your license allows, resulting in a "pester" dialog that tells users to contact the administrator. Installation also lets you import NetWare groups and configure the defaults for the message editor. A full installation swipes

2.7MB of server disk space, sans user directories. Single-server environments don't require MHS; multiserver setups do. MHS-based servers will read the Bindery and automatically synchronize when users are added.

SUITABILITY TO TASK

Notework Electronic Mail

	POWER	EASE
Mail server installation	Fair	Fair
Maintenance	Fair	Fair
Client installation	Fair	Good
Basic messaging	Fair	Good
Advanced messaging	Fair	Fair
Remote	Fair	Fair

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Administration functions are fairly limited, partly because there aren't many, and partly because those features that exist are accomplished via several separate DOS utilities and the creation of ASCII files. With the latter, you have to remember not only the text filename for each setting, but also where the files are; otherwise, you need the manual. Ideally, the package would have one central program where all administration features are performed.

An example of the problem of administration via text files: Connecting to multiple servers requires the creation—after you install Notework on each server—of a text file in each Notework system directory listing the paths to other Notework servers. Running NWXBIND parses the text file and binds the servers. Similarly, adding or removing servers requires a trip to your favorite text editor. If WANs are your game, brace yourself. After playing administrator Twister getting MHS installed, you'll need to equip yourself with a Notework MHS gateway.

The main administration program, NWSYSCON, lets you specify how long deleted mail hangs around before obliteration from the server's disk (you can choose Immediately or 1, 2, 7, or 30 days). NWSYSCON also lets you modify log-on scripts and create Notework-specific user groups (requiring you to create an ASCII file and type the name of every user you want in the group and then run NWSYSCON). Other utilities let you modify Notework's front-end menu structure (NWMENU), clear mail from the trash (NWCLEAN), resend mail between

FACT FILE

Notework Electronic Mail, Version 3.0

On Technology, One Cambridge Center,
Cambridge, MA 02142; 800-767-6683; fax,
617-374-1433



List price: Ten users, \$590.
Requires: 5K RAM, DOS 3.1 or later, Microsoft Windows 3.1 or later, NetWare 2.x or later
MHS: The package is a native MHS application. MHS 1.5 or Global MHS is required for external connections.

In short: Notework Electronic Mail delivers good basic messaging with Windows and DOS clients, but it lacks advanced features such as enhanced security, control of user disk space, backups, and public and private folders. Furthermore, administrators have to execute many administrative changes via text files; it would be better if the administration tools were more centralized. Notework's Windows client still feels DOS-like and doesn't support drag-and-drop, OLE, or DDE. Users can access as messaging options handy Flash, Notes, Phone Messages, and Speed Read features. Notework has limited folder and attachment support, and users can't create their own mailing lists. Also, the remote client is difficult to set up.

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servers (NWRESEND), get mail statistics (NWSTATS), and perform a few additional housekeeping chores.

Absent are utilities to create or manage public folders, specify user privileges and security levels, limit user disk space, create bulletin boards, or back up the mail system.

The lack of centralized control is a mark against the package: Overburdened administrators simply don't have the extra time for the package's decentralized administration features. Notework's NetWare-like help (NWHHELP.EXE) does give quick access to most of the

info you'll need. But a Windows-based front end, which even NetWare now boasts in Version 4.0.x, would deliver quick, easy, centralized control over your Notework installation and maintenance.

On the other hand, Notework will do well on typical small networks (accommodating 20 to 40 users) that sport a mix of DOS and Windows users and one server. Companies nursing along aging 286s will likely welcome Notework's frugal requirement of only 5K of RAM for the DOS TSR. Those administering multiple server, multiple gateway LANs and WANs with hundreds of users, however, should probably look elsewhere.

END USER

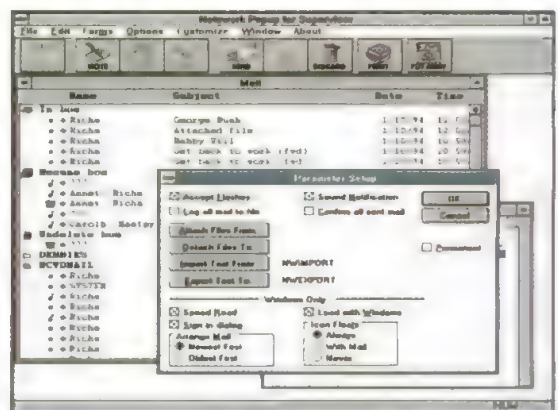
End users with simple e-mail needs who desire a package that sends and receives

mail and offers basic folder capabilities will be well satisfied by Notework's Windows interface. The DOS interface, by comparison, has basic e-mail features but not the more advanced items like OLE. Notework has no on-line help, but it does include a quick reference card.

To set up Notework on a workstation, you can either run the user installation (NWUSERS.EXE) from DOS and then run the DOS or Windows program, or you can simply load NW* from the DOS prompt. As you run the Windows Notework program (NWW.EXE) the first time, you can have it automatically modify your WIN.INI to start Notework when you start Windows.

The toolbar in Notework's Windows client gives you easy access to the most common e-mail operations. Sending a message is quite easy, though you're limited to 10K of text. First, pick the type of message you want. Notework lets you broadcast Notes (Urgent, Wide, and Standard) and Phone Messages (great if you don't have voice mail). There's also the Flash feature, which pops the message up on the recipient's screen—if they're logged in. Next, you choose the recipients, including the carbon copy and blind carbon copy recipients, from one dialog box. All that remains is to type a subject, enter your message, and click on the toolbar's Send button.

Reading messages is just as quick, es-



Notework's small parameter list lets you fine-tune the package to suit your needs.

pecially with the Speed Read feature enabled. Speed Read opens the most recently received message when Notework is activated (though you can also change the sort order). In terms of messaging

SOFTWARE

E-Mail

speed, Notework is hard to beat, which makes its poor folder capabilities all the more frustrating. While you can create up to 64 folders, you can't nest them—a definite shortcoming. Notework handles replies to the original sender with aplomb but makes forwarding unnecessarily obtuse; replies are essentially forwards if you include other recipients. Such mixtures of ease and confusion abound, and they are Notework's most egregious failing. For example, messages are marked with small, easily understandable icons that indicate message type. Then, however, Notework turns around and labels the trash folder the "Undelete box" and stores copies of sent mail there, along with your discarded messages.

On Technology's insistence that both DOS and Windows versions operate identically means that Windows users lose out. You can't drag-and-drop messages from one folder to another, embed documents, or even modify or delete folders once they're created. Users can't create their own personal mailing lists; only the administrator can create and read mailing lists in NetWare- and Notework-created user groups. Also, you can't view an attachment or click on it to load it into its native application. Another shortcoming is that you can only sort by date within folders.

Notework does have a remote client (\$149), but it requires the MHS gateway, making it difficult to install. Its feature set provides the basics of remote capability—no more than that.

Notework is stable, steady, and very easy to use, but it's best only for basic messaging. More sophisticated users, especially those working in larger network environments, will find its shortcomings—as well as its very simplicity—restrictive.

Finansa Ltd.

WinMail

BY DAVID HARVEY AND RICH SANTALES

Finansa's WinMail, Version 1.5c, makes a successful Atlantic crossing, offering savvy DOS and Windows messaging at \$595 for a ten-user version. Its particular claims to fame are its native MHS sup-

port, robust filtering of messages into folders, very solid handling of message lists and addresses, and ability to share public folders and thereby create a quasi-BBS structure.

ADMINISTRATOR

Users can choose either a basic or an advanced server installation. WinMail's fully Windows-based basic installation on both the front and back ends is about as easy as it gets, offering a no-brainer route to nearly instant e-mailing, while the advanced installation provides the ability to enable public folders and define the volume and path for user mail directories and shared files. MHS is required for advanced, multiserver setups only; single-server setups do not require MHS, unless the remote client will be used. WinMail ships with MHS.

Basic installation takes only 20 minutes. Advanced installations—for connecting outside e-mail services, gateway and servers, and hundreds of users—can take anywhere from half an hour to several days, however, depending on the complexity of the arrangement. Although WinMail recognizes NetWare Bindery users and groups, it requires that you add each user one at a time—unlike some other packages. Notework Electronic Mail, for example, blazes through this process, sucking up batches of users in seconds. Our test installation consisted of 50 users; we shudder to think how long it

SUITABILITY TO TASK		
WinMail		
	POWER	EASE
Mail server installation	Fair	Fair
Maintenance	Fair	Fair
Client installation	Fair	Good
Basic messaging	Fair	Good
Advanced messaging	Good	Fair
Remote	Fair	Fair

would take to install WinMail's maximum 26,000 users.

Connecting to WinMail hosts on other servers is as easy as the main installation if MHS is already present, thanks to WinMail's native MHS support. With MHS and WinMail installed, we logged in as the administrator and hooked up to another

FACT FILE

WinMail, Version 1.5c

Finansa Ltd., 200-204 High St. South,
Dunstable, Bedfordshire LU6 3HS;
071-405-4054; fax, 071-831-5737



List price: Ten users, \$595

Requires: 640K RAM, 1.7MB hard disk space on server (not including user directories or message space), Microsoft Windows 3.x, NetWare 2.1 or later.

MHS: WinMail is a native MHS package. It requires MHS 1.1 or later for multiple-server environments and remote connections. WinMail comes with MHS

In short: Integrated MHS support, sophisticated filtering, and a strong remote package make WinMail a viable e-mail choice. But while basic installations are easy, more advanced installations require a great deal of time and effort. Administrators have utilities for host and public address-book and list maintenance. WinMail automatically handles many other administration tasks, such as reclaiming space. End users have access to sophisticated folder filtering and detailed notification features. WinMail's remote client is fairly strong

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NetWare server running MHS in just three mouse clicks.

The only real administration feature WinMail includes is host and public address-book and list maintenance. It automatically handles most other administration tasks, such as reclaiming space and emptying trash cans on a user-by-user basis. Backups are the duty of your existing server backup system. For both new administrators and old hands who are short on time, WinMail's set-it-and-forget-it approach to maintenance will win smiles. But an e-mail package that revels in its simplicity and power should deliver a better method of quickly adding users.

END USER

Enabling a workstation with WinMail's Windows client simply involves running USERINST.EXE from the server, which creates a program group and icon and modifies the local WIN.INI, adding a command to invoke the background notifier (WMSEC.EXE). No local disk space is required. In place of WMSEC, DOS

clients who desire mail notification will have to run a 4K TSR.

The WinMail client has a clean interface, solid and basic message abilities, rich automatic message filtering, and excellent notification. Preparing a quick message is a simple matter: Hit Ctrl-P, click the Toolbar's Prepare button, or se-

instance, define a basic filter that has the package automatically stuff all mail from your boss into a "boss" folder and pop up a dialog to remind you every 10 minutes if there's any unopened mail from your boss. Increasingly complex filters that let you sort by priority and sender—as well as by text in headers, messages, and at-

tachments—can have the package, for example, copy memos from sales-group members into sales folders for different regions.

Coupled with this robust filtering, WinMail's detailed notification dialogs stand apart from what the pack has to offer in this area. Most e-mail packages merely flash an icon or play a sound when mail is received in the background. WinMail pops up a dialog detailing how many messages arrived, who sent them, and where the messages were placed depending on the filters

dication that Search mode is active is a small *Search* on the status bar. Consequently, brief panic attacks occurred whenever we forgot to disable search mode and discovered suddenly empty storage folders.

WinMail does a good job with its separate remote package (\$295). During installation, a help file automatically pops up to aid in customizing the type of connection you're making and the modem you'll be using. If you opt for the full package, you'll need 2MB of disk space. WinMail Remote is virtually identical to the desktop package but adds a Connect menu item that lets you choose connection time and configure modem settings. WinMail Remote also lets you establish additional settings on the Administrator menu to manage users and connection scripts. As with WinMail proper, you get a notification dialog box when you receive mail, and you can hook up from either DOS or Windows. You can't download message summaries or preview mail remotely, but you can choose between sending and receiving, choose the maximum message size for retrieval, and connect either on demand or based on a schedule. You can also read already-opened messages.

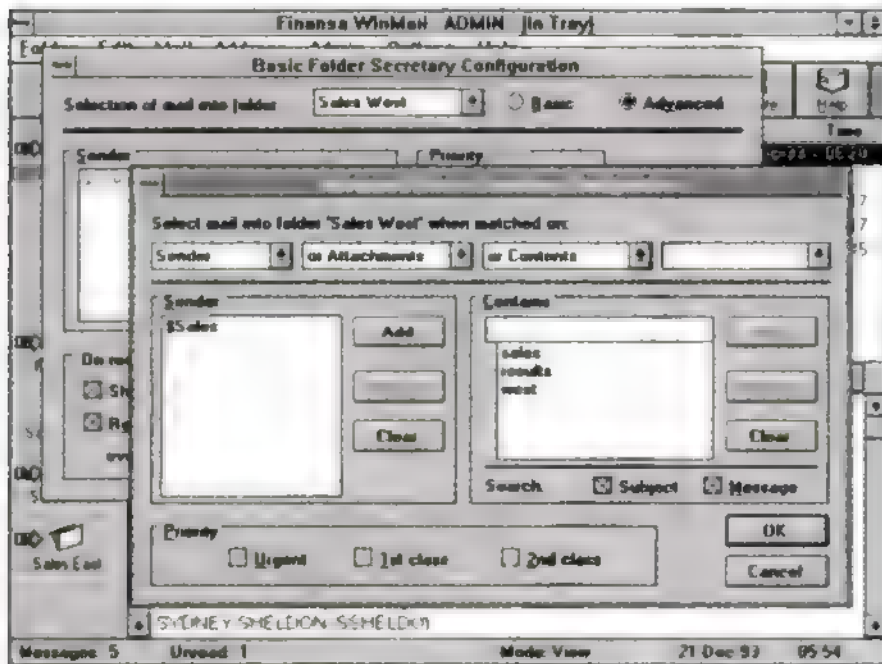
WinMail's outstanding Secretary feature and notification program are offset by its disappointing user-by-user installation and lax security, which ultimately places it into the category of frustratingly excellent. WinMail lacks the niceties we have come to expect in cutting-edge e-mail packages, and it hardly breaks new ground. Still, we have high hopes that WinMail will prove a solid, productive e-mail citizen in its next version.

WordPerfect Corp.

WordPerfect Office

BY RON ANDERSON AND
PADRAIC BOYLE

WordPerfect Office, Version 4.0, from WordPerfect Corp., includes a very capable multiplatform e-mail system that incorporates a plethora of personal and workgroup messaging features. It has the user and administration tools necessary to support corporate messaging ac-



WinMail offers advanced filtering of incoming messages. Mail can be filed into folders according to any combination of sender, text, subject, and priority.

lect Prepare from the Mail menu and a blank message pops up.

Type in a subject, press Tab to type in the body text, click Send, and pick the recipients from a dialog box. From the initial send dialog you can select names from your active public or private address book or mailing list. By clicking the Options dialog button, you get a further dialog that allows you to send carbon copies to any number of installed users. The same dialog handles blind carbon-copy addressing too. Additional radio buttons and check boxes in the dialog let you select three levels of message priority and determine whether a copy is kept. There you can also opt for message encryption and a return receipt.

Unfortunately, there's no customizable toolbar or spell-checker, font choices, text-styling features, adjustable margins, or phone notepad templates. But WinMail can print either single messages or the contents of entire folders in summary or detailed form, and attaching files is painless.

You can't nest folders, but WinMail's folder filtering and Secretary feature more than make up for the omission. Secretary lets you set up quite detailed filtering to each of your folders. You can, for

you've created.

WinMail's lack of security is a potential concern. Its security begins and ends with your in-place NetWare security restrictions. Anyone with access to individual WinMail user directories can read message contents; stored messages aren't encrypted. Moreover, WinMail is not password protected.

Possibly confusing is WinMail's practice of storing a copy of sent mail in the out tray. Users without access to manuals—a common situation on LAN-based e-mail networks—may think the messages weren't sent, since, to many users, an out tray typically holds unsent items.

Another potential source of confusion is WinMail's search feature. Unlike conventional search features—which have a program shuffle off to track down info after a command has been executed—WinMail's search feature acts like a filter mode. Using a dialog box very similar to the Secretary dialog box, you define a "filter" based on date, priority, status, sender, and message content. You then toggle in or out of search mode. The feature works well, leaving only the messages that pass your filter displayed in each folder. But the sole in-

tivities and manage workgroup tasks and work flow. At a list price of \$295 per server and \$35 to \$99 per user (depending on volume), this package will serve your corporate messaging needs better than any other package in its price range.

We looked at Office's DOS, Windows, and remote-client software. The package also supports Macintosh and

selected users, or add users from an ASCII file.

Client software is installed on users' local disks from your network file server (except for the remote client). You can do a local installation, which transfers all of the executables to a user's hard disk, or you can do a network installation, which prepares a user's workstation to run the executables from the network file server. Local installation requires considerable time and disk space, especially for the Windows client, which occupies 13MB of disk space. It took us nearly half an hour to install it on one machine (transferring all the executables from the network to the user's hard disk). The DOS client takes up around 5.5MB of disk space; the remote client needs 4.2MB.

Office has a proprietary message-transport system, Message Server (called Connection Server in earlier versions), that handles everything from simple message transport to messaging among servers, post offices, and remote sites. You need a dedicated PC to run both the Message Server software (unless you have only one post office) and the ASYNC dial-in software (included in the base package for remote dial-in capability). Queuing is an essential part of Office's messaging service: Messages are sent to a

queue before they are distributed to their post-office destinations. This process may be run on the same PC as Message Server, depending on the size and traffic of your network, or on a separate PC to speed up message delivery.

Office's ability to connect to dissimilar networks and e-mail packages via optional gateway software is one of its strengths. It offers gateway support to many of the major messaging systems such as cc:Mail, IBM PROFS and IBM SNADS, SMTP (Simple Mail

Transport Protocol), Digital Equipment Corp.'s VMS and All-in-One, and X.400. And Office's cc:Mail and PROFS gateway products provide Directory Synchronization, a feature that lets you convert users between two dissimilar e-mail platforms and retain the ability to

FACT FILE

WordPerfect Office, Version 4.0
WordPerfect Corp., 1555 N. Technology Way, Orem, Utah 84057; 800-451-5151; fax, 801-222-5000



List price: Five users, \$495.

Requires: Server: 500K RAM (2MB extended or expanded), 40MB hard disk space. DOS workstation: 450K RAM. Windows workstation: 4MB RAM (extended or expanded)

MHS: MHS is not required, but the package supports MHS, and an MHS gateway is available.

In short: WordPerfect Office is a stand-out corporate messaging product. The package includes clients for DOS and remote DOS, Windows, Macintosh, and Unix. Myriad gateways are also supported. Post-office directories are automatically synchronized, and management of the entire enterprise-wide system can be accomplished from an administrator's DOS workstation. Features such as rules and folder support, as well as drag-and-drop, are integrated with personal and group scheduling and task-management features. A file-viewing utility also enhances messaging capability, and an additional forms package can be purchased for workflow enablement.

 ON READER SERVICE CARD

administer the mail-user database from one package. In the process, Office provides the capability to preserve the existing mail in each user's mailbox. Office also offers Directory Synchronization for VMS mail, but only in one direction—from VMS to Office. Also included is an API gateway product that lets you take some of the hooks from other products and link them to your e-mail and a fax gateway for sending outbound faxes.

Office's systems-reporting capabilities include listing information regarding domains, post offices, and users. Unfortunately, these reports lack some items that most administrators seek, such as details on disk space in use.

END USER

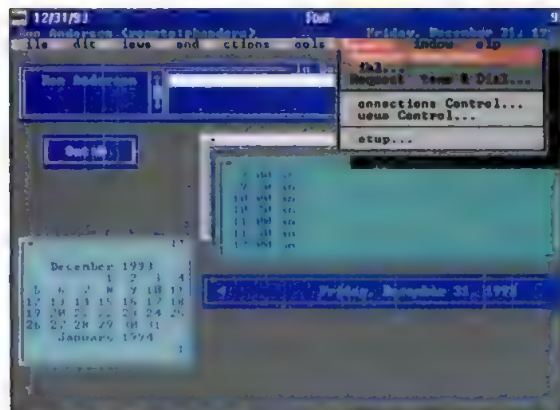
The DOS and the Windows clients each have a healthy supply of features, including rules and routing features, a spell-checker, a thesaurus, and file and folder managers. An integrated PIM and group

SUITABILITY TO TASK		
WordPerfect Office		
	POWER	EASE
Mail server installation	Fair	Fair
Maintenance	Good	Good
Client installation	Fair	Fair
Basic messaging	Fair	Good
Advanced messaging	Good	Good
Remote	Fair	Fair

Unix clients (plans for an OS/2 client were recently shelved).

ADMINISTRATOR

Office provides administrators with a fairly easy-to-use, DOS-based front end to set up, configure, and add users. Server installation is not difficult to perform, but you do need to review the documentation thoroughly and decide on a direc-



WordPerfect Office's DOS-based remote client includes a special menu for managing remote requests.

tory-naming scheme before beginning. You use the administrator program's simple pull-down menus to add users from popular network operating systems such as Banyan's VINES, IBM's LAN Server, Microsoft LAN Manager, or Novell's NetWare. You can choose all or

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CIRCLE 052 ON READER SERVICE CARD

SOFTWARE

E-Mail

scheduler provide calendars and task-management support.

The Windows client surpasses the DOS client; it includes all of the bells and whistles we've come to expect in a robust e-mail package—macros, client and server OLE and DDE support, an OLE container and server, drag-and-drop addresses, and a nicely animated introductory tour. Each client package offers context-sensitive help and a nifty "How Do I..." help feature that takes you through more than 40 of the program's more complex features. A useful manual is included with both clients.

When you start the Windows client, the main window presents selections for accessing the package's major features—personal calendar, mail, group scheduling, and task management. Drop-down menus duplicate the icons' functionality. A feature unique to Office is The Shelf, a blank window analogous to a group window in the Windows Program Manager, where you can add your own icons.

The interfaces of the DOS and remote clients (the latter is DOS-based) are highly graphical, the DOS one so much so that a mouse is almost a requirement. Both utilize multiple, simultaneous open windows and pull-down menus. The remote client includes a Remote menu selection to handle requests for selective downloads, batch processing, and asynchronous connections. Otherwise, the DOS and remote clients are nearly identical.

In all Office clients, messaging is a straightforward, forms-based process. Fill in the To: and (optionally) the CC: and BCC: fields via either the keyboard or pick-lists (the Windows client supports drag-and-drop), key in the "Subject" field, and type or import text into the message body. Replying to and forwarding messages is as easy as clicking a button, and Office gives you the ability to route a message to a sequence of recipients. You can easily trace the history of your message from the time you send it. Information about a particular message—who has read it and who hasn't, whether or not it has been routed to the next recipient, and

so on—is a click away.

Furthermore, you can create and nest folders to your heart's content, and messages can be archived or deleted automatically according to criteria you set.

In the Windows client, you can drag-and-drop messages from one folder to another and attach files to messages by dragging them from the file manager to the body of the message. The DOS client presents a pick list for attachments. Attached files can be extracted from messages and saved to local storage. In the Windows client, you can click on the attachments to have them load into their native applica-

tions. You can also create rules via an easy fill-in-the-blanks process. You define rules in a when-if-then form to manipulate virtually any incoming event. Also, you can search for messages in your folders by text in the From, To, and Subject boxes and in

the body of the message. You can sort folder contents by the Item Type, From, To, or Subject field.

Both clients include Outside-In, the file-viewing utility from Systems Compatibility Corp. that lets you view and print attachments even if you don't have the application that originally created them. The utility's viewers support more than 150 file formats. The DOS client also includes a small notification TSR (10K) that alerts you to new mail and optionally starts Office with the new mail opened for your perusal.

One drawback is that Office proved to be slow—not just in Windows but also in DOS. You'd be well advised to run it on a system with more punch than the 386/16SX machines we used.

Office belongs on the short list of e-mail candidates for a wide variety of organizations. Its excellent gateway support may make it more appealing to larger businesses—especially those undergoing the painful process of right-sizing and converting their PROFS mail. Office's personal and group scheduling, task scheduling, and work-flow management complement its feature-rich e-mail core, producing a powerful integrated messaging system. □

*Office's personal and
group scheduling, task
scheduling, and work-flow
management complement
its feature-rich e-mail core.*

How often have you executed a DOS command only to have the information you need scroll off the screen? Check out this issue's free utility: PERUSE lets you capture the display information then review it whenever you need.

User-to-User

BY NEIL J. RUBENKING

Inconsistencies in DOS's Command Line Limit

use DOS 4.0. While trying to extend the logic of GETLEN.BAT (User-to-User, March 30, 1993), I discovered that the DOS command line is effectively *shorter* than 127 characters when an environment variable is included. Apparently, when a value is substituted for a variable name such as %e%, the space of the trailing % character is not released. And if the length of the value is sufficient to push the trailing % character past byte 127, DOS forgets that it is executing a batch file!

I wrote a batch file that tests this behavior. TESTCMD.BAT (shown in Figure 1) attempts to ECHO four strings composed of three repetitions of a command line parameter or an environment variable plus a ten-character literal string. In DOS 4.0, the behavior of this batch file depends on the length of the parameter.

With a parameter length of 38 or less, the batch file runs to completion. But the lines that involve an e-var are not truncated to 127 characters. With strings of 39 or more bytes, the command ECHO &%%&%%&abcde-fghij causes DOS to drop back to the C:\> prompt without completing the batch file. Is the behavior I've observed unique to my version of DOS, or is it generic?

Wayne R. Murray
Fairfax, Virginia

►PC MAGAZINE: The 127-character limit on the length of batch file lines is *supposed* to apply after all command line parameters and environment variables have been replaced by their values. While investigating Mr. Murray's discovery, I found that only DOS 5.x and 6.x correctly follow this specification. Even then they display one minor discrepancy.

I started with the simple batch file **LIMIT127.BAT** (Figure 2). It executes three test lines that are all longer than the 127 character limit. The first of the test lines contains "ECHO ", 121 x characters, and 12 exclamation points, for a total of 138 characters. DOS should chop it off after the 127th character, which is the first exclamation point. The second test line replaces each x character with %1, for a total of 259 characters. However, after each %1 is replaced by its value (which is simply x), the line is identical to the first and should produce the same output. The third test line replaces each x character with %x%, a reference to the environment variable named x, whose value is also x. The line is 380 characters long, but after DOS replaces each variable with its value, this line is again the same as the first line. Most DOS versions handle

TESTCMD.BAT

Complete Listing

```

@ECHO OFF
REM TESTCMD.BAT - tests DOS's truncation of command
REM   lines that expand to more than 127 characters.
IF NOT %0==%GOTO Test
CALL %0 xxxxxxxxxxxxxxxxxx2xxxxxxxxxx3xxxxxxxxx 38
CALL %0 xxxxxxxxxxxxxxxxxx2xxxxxxxxxx3xxxxxxxxx 39
CALL %0 xxxxxxxxxxxxxxxxxx2xxxxxxxxxx3xxxxxxxxx4 40
      %0 xxxxxxxxxxxxxxxxxx2xxxxxxxxxx3xxxxxxxxx4x 41

:Test
CLS
ECHO Parameter length %2
ECHO XXXXXXXXXXXXXXXXXXXX-
SET &=%1
ECHO ECHO %%%1%%1%ab cdefghij
ECHO %%1%1%ab cdefghij
ECHO          Last character should be here ^
ECHO.
ECHO ECHO abcd efgh ij%%1%%1%%1
ECHO abcde fghi j%1%1%1
ECHO          Last character should be here ^
ECHO.
ECHO ECHO %%1%%1%%1%%1%%1%%1%%1%ab cdefghij
ECHO %%1%%1%%1%%1%ab cdefghij
ECHO          Last character should be here ^
ECHO.
ECHO ECHO abcd efgh ij%%1%%1%%1%%1%%1%%1%%1
ECHO abcde fghi j%%1%%1%%1%%1%%1%%1
ECHO          Last character should be here ^
ECHO          (but in MS-DOS 5 and 6 it's one short)
PAUSE

```



Figure 1: This batch file tests DOS's handling of too-long command lines, revealing a major problem in DOS 4.x and a minor problem in DOS 5.x and 6.x.

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LIMIT127.BAT

Complete Listing

```
ECHO OFF
IF NOT 0%10==0x0 %0 x
SET x=x
ECHO This batch file should print three identical too-long lines containing
ECHO 121 repetitions of the letter x and ending with ONE exclamation mark.
REM 138 characters: "ECHO " + 121 of "x" + 12 exclamations
ECHO xx ... xx!!!!!!!!!!!!!!
REM 259 characters: "ECHO " + 121 of "%1" + 12 exclamations
ECHO %1%1% ... %1%1!!!!!!!!!!!!!!
REM 380 characters: "ECHO " + 121 of "%x%" + 12 exclamations
ECHO %x%%x% ... %x%%x%!!!!!!!!!!!!!!
SET x=
```



Figure 2: The lines of LIMIT127.BAT are as much as 380 characters long, but after evaluating parameters and variables, DOS truncates them correctly. (Note that for reasons of space this listing does not include the 121 x characters).

CHOP127.BAT

Complete Listing

```
ECHO OFF
IF NOT 0%10==0ABC0 %0 ABC
SET x=ABC
ECHO This batch file echoes two lines of 119 xOs. The first ends with
ECHO %1, which should evaluate to "ABC". The second ends with %%x%,
ECHO which should also evaluate to "ABC". In DOS 5 or 6, the
ECHO second line is one character short.
REM Next line is "ECHO " plus 119 xOs plus "%1"
ECHO xx ... xx%1
REM Next line is "ECHO " plus 119 xOs plus "%x%"
ECHO xx ... xx%x%
SET x=
```



Figure 3: DOS 5.0 and 6.0 chop one character too many from the second display line in this batch file. (Note that for reasons of space this listing does not include the 119 x characters.)

LIMIT127.BAT correctly, but DOS 2.0 locked up solid when attempting to process the too-long lines.

Next I tried the batch file CHOP127.BAT (Figure 3). The main difference between this and LIMIT127 is that the command line parameter or environment variable comes at the very end of the extra-long batch line. Oddly enough, DOS versions 4.x and below handle this batch file just fine, while DOS 5.x and 6.x lose the last character of the environment variable!

After this warm-up, I ran TESTCMD.BAT (modified to try parameters of four different lengths automatically) under various DOS versions. DOS 5.x and 6.x passed with flying colors (except for losing the last character of the environment variable as they did in CHOP127). DOS versions before 4.x correctly truncated the overlength lines that

were produced by evaluating a command line parameter, but they failed on the lines produced by evaluating an environment variable. As for DOS 4.0 itself, it was a disaster! Mr. Murray reported that DOS simply broke out of the batch file, but I got results varying from system lockups to

spontaneous screen printing to activation of random DOS commands.

The lesson is clear. Batch files such as GETLEN.BAT that rely on DOS's stated method of truncating overlength command lines must be tested under all DOS versions. They will be

consistently dependable under only DOS 5.x or 6.x, and even then you must avoid environment variables at the end of lines that are to be truncated.

You can download these batch files from PC MagNet's Utilities/Tips Forum TESTCM.ZIP.

*Batch files that rely on
DOS's method of truncat-
ing overlength command
lines must be tested under
all DOS versions.*

A Smart Expand Command

I've found the lack of intelligence in DOS's EXPAND.EXE frustrating. Microsoft and other vendors use this utility along with SETUP.EXE to expand the compressed versions of new software onto your hard disk from upgrade or installation floppy disks. When installing DOS 6.0, I chose to install the new virus and backup utilities for Windows only. Later I wanted to add the DOS versions, but I didn't want to do a complete reinstallation.

I had used EXPAND.EXE on previous occasions to expand selected files from my Windows 3.1 installation disks and found that I could do the same for the MSB*. (MS-Backup for DOS) and MSA*. (MS-Antivirus for DOS) files. EXPAND.EXE doesn't take wildcards as input, however, nor is it smart enough to realize that a compressed file with extension DL_ or EX_ can consistently be assumed to represent a .DLL or .EXE file when expanded. So I created MEXPAND.BAT, shown in Figure 4 to supply this additional functionality. I've used the batch file many times since my installation of DOS 6.0.

To expand one file, just pass its filename to MEXPAND, optionally including a drive letter. The expanded file will be placed in the current directory on drive C:. To expand a number of files, use the FOR command like this

```
FOR %v IN (A:*.*) DO MEXPAND %v
```

The DOS 6.0 CHOICE command isn't vital to the functioning of MEXPAND.BAT, but QBasic (which came with DOS 5.0) is required.

Michael Bee
Richfield, Minnesota

►PC MAGAZINE: Like the antiquated SQUEEZE compression program, Microsoft's COMPRESS utility marks a compressed file by wiping out part of its filename. SQUEEZE replaced the second character of the extension with a Q, while COMPRESS replaces the last character with an underscore. When SETUP runs EXPAND to decompress these files, it has a script that tells what the name of the decompressed file should be in each

MEXPAND.BAT

Complete Listing

```
@ECHO OFF
ECHO F$ = UCASES("%1")
ECHO Ext$ = ""
ECHO IF INSTR(F$, ".DL_") THEN Ext$=".DLL"
ECHO IF INSTR(F$, ".EX_") THEN Ext$=".EXE"
ECHO IF INSTR(F$, ".OV_") THEN Ext$=".OVL"
ECHO IF INSTR(F$, ".HL_") THEN Ext$=".HLP"
ECHO IF INSTR(F$, ".38_") THEN Ext$=".386"
ECHO IF INSTR(F$, ".GR_") THEN Ext$=".GRB"
ECHO IF INSTR(F$, ".CO_") THEN Ext$=".COM"
ECHO IF INSTR(F$, ".SY_") THEN Ext$=".SYS"
ECHO IF INSTR(F$, ".DR_") THEN Ext$=".DRV"
ECHO IF INSTR(F$, ".BI_") THEN Ext$=".BIN"
ECHO IF INSTR(F$, ".VX_") THEN Ext$=".VXD"
REM other possibilities:
REM ZGR, 3GR, FON, RLE, BMP, WAV,
REM SCR, MID, WRI, CFG, INI, TTF
ECHO IF Ext$ = "" THEN SYSTEM
ECHO OPEN "MEXPANDT.BAT" FOR OUTPUT AS #1
ECHO Strt = INSTR(F$, ":") + 1
```

```
ECHO Fin = INSTR(F$, ".") - 3
ECHO HD$ = "C:" + MID$(F$, Strt, Fin) + Ext$
ECHO PRINT #1, "MEXPAND "; F$ ; " "; HD$
ECHO SYSTEM
QBASIC /RUN MEXPAND.BAS
IF EXIST MEXPANDT.BAT GOTO Continue
ECHO Error: Unsupported extension "%1"
PAUSE
GOTO End
:Continue
TYPE MEXPANDT.BAT
CHOICE /C:YN /T:Y,5 CONTINUE
IF ERRORLEVEL 2 GOTO Exit
CALL MEXPANDT.BAT
:Exit
DEL MEXPANDT.BAT
:End
DEL MEXPAND.BAS
```



Figure 4: MEXPAND gives the DOS EXPAND program more intelligence by automatically selecting the output filename's extension.

case. When you use EXPAND, you have to supply the name of the resulting file.

As Mr. Bee points out, there's rarely any doubt. In almost every case, DL_ becomes DLL, CO_ becomes COM, and DR_ becomes DRV. MEXPAND.BAT handles 11 common extensions, and you can easily add more. For example, if you find yourself expanding Visual Basic custom control files, insert a line like

```
ECHO IF INSTR(F$, ".VB_") THEN
Ext$=".VBX" >> MEXPAND.BAS
```

It's not easy for a batch file to check whether one text string contains another, but QBasic easily makes such comparisons. On the other hand, a QBasic program can't handle command line parameters the way a batch file can. MEXPAND is a clever melding of batch and QBasic

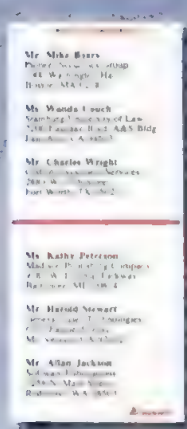
that gets around the shortcomings of each. The batch file hard-codes its own first parameter into the QBasic program and then runs the QBasic program to create another batch file. Remember this technique when you need to pass command line parameters to a QBasic program!

You can download MEXPAND from PC MagNet's Utilities/Tips Forum archive as MEXPAN.BAT □

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Tutor

BY JEFF PROSISE

DLLs and Module References in Windows

Have you ever tried to run a Windows program and received an error message like this one:

File Error
Cannot find DDEML.DLL

followed by one saying, "Cannot find *programname* (or one of its components). Check to ensure the path and filename are correct and that all required libraries are available."?

Windows is telling you that the program you just tried to start requires a DLL called DDEML.DLL and that DDEML.DLL is nowhere to be found. Windows knew that the program required the services of DDEML.DLL and tried to load it ahead of time. When Windows couldn't find the file, it output the error message.

For the vast majority of Windows users, the term *DLL* is like a stop sign that reads, "Go no further; the following information is for programmers only." There is precious little information to be found on DLLs outside of programming literature, and yet DLLs form the very foundation on which Windows is built. The three main files that make up Windows—USER.EXE, GDI.EXE, and KRNL386.EXE (in 386 Enhanced mode) or KRNL286.EXE (in Standard mode)—are DLLs. So are many of the other files found in the directories where Windows is stored. Chances are that many of the Windows programs that you run every day use DLLs. The fact that all this happens with-

out your knowledge is a credit to Windows' robust design. In most cases, everything that a Windows program does with a DLL goes on well behind the scenes, requiring no intervention by the user. Only when things break down does Windows require that we mortals step in and do something.

Windows does such a good job of hiding a program's dependencies on DLLs that it's difficult to determine what, if any DLLs a program requires. This information is obviously stored somewhere, because Windows knows what DLLs to load when a program is started. There are plenty of situations in which knowing whether a program uses DLLs is useful, and if it does, what the DLLs' names are. Suppose you're removing a Windows application from your hard disk, for example. How do you know which DLLs to delete if they're installed in the same directory as other applications' DLLs. It turns out there is a way; you'll learn about it in a moment. First, let's briefly review what DLLs are and how they work.

DLL BASICS DLL stands for *dynamic link library*. A DLL is a special type of Windows program that contains code, data, or both code and data that other

programs can use. In this case, *code* means functions that other programs can call. USER.EXE, for example, contains more than 400 functions that embody such useful tasks as creating a window and retrieving a message. *Data* usually means resources such as icons, fonts, and menus. Windows allows resources to be linked into a program's .EXE file, where they are private to the program, or stored in a DLL, where any program can access them. Most DLLs contain lots of code and little or no data. Some, however, contain all data. These are called resource-only DLLs. The files with the extension .FON, for example, are resource-only DLLs containing fonts.

The best way to understand the concept of dynamic linking is to contrast it with the process known as *static linking*. In traditional, static-link programming environments, functions called from programming libraries are bound (linked) into a program's .EXE file. For example, when the program that does the linking (the *linker*) processes a C program file that calls the printf() function (which out-

There is precious little information to be found on DLLs outside of programming literature, and yet DLLs form the very foundation on which Windows is built.

puts a line of text to the screen), the linker physically copies the code for the printf() function from a static link library to the executable. Through static linking, the code from the library becomes a permanent part of the program.

Dynamic linking accomplishes the same task as static linking, but the code in the library module (the DLL) is never

linked to the .EXE file. When Windows loads a program that calls a function or uses a resource stored in a DLL, Windows loads at least a portion of the DLL into memory if it isn't already loaded. Then, through dynamic linking, the program can call functions or use resources within the DLL as easily as if they had been statically linked. Dynamic linking offers several advantages that static linking does not. For example, if several different programs (or multiple instances of the same program) use the same DLL, the DLL has to

be loaded only once. The programs share the DLL, and less memory is required than if the DLL's functions or resources had been duplicated in each .EXE file. Dynamic linking is one technique that Windows uses to conserve memory. While frugal use of memory is always important, it was critically important in early versions of Windows, which ran only in Real mode and were therefore constrained to 640K of memory just like DOS.

Figure 1 illustrates how programs using a static link library differ from programs sharing a dynamic link library. The diagram on the top depicts three concurrently running programs with identical functions linked in from a static link library. The library functions' code appears three times in memory, bound to the programs. The diagram on the bottom shows how the same programs would look if they used dynamic linking. Now the library code appears only once, resulting in a memory savings equal to twice the library-code size.

When Windows needs to load a DLL, it looks in several places for the file containing the DLL. First, it looks in the current directory. If the DLL isn't in the current directory, Windows then looks in the Windows directory (\WINDOWS on most computers), followed by the Windows sys-

tem directory (\WINDOWS\SYSTEM). If the DLL still hasn't been located, Windows looks in the directory the program requiring the DLL was loaded from, in the directories listed in the DOS PATH environment variable, and finally in any mapped network directories. If none of these checks turns up the DLL, Windows displays an error message like the one shown earlier. Once the DLL is loaded, Windows does some fancy maneuvering to facilitate the program's access to the DLL. Among other things, this involves building objects called *reload thunks*.

Reload thunks load the portion of a DLL that contains a func-

tion into memory when the function is called (if that portion of the DLL isn't already in memory), and then they jump to the appropriate address inside the DLL. The subject of reload thunks is rather complex, and a thorough understanding requires some knowledge of programming. If you're interested in learning more, you should take a look at chapter 7 of Charles Petzold's classic *Programming Windows*, published by Microsoft Press.

THE MODULE REFERENCE TABLE All of this begs a bigger question: How does Windows know which, if any DLLs to load when a program is started? The answer lies in several structures of the Windows .EXE file. Every .EXE file begins with a file header, and Windows programs add to that another header known as the Windows header or the NE (for *new executable*) header (see Figure 2). The NE header contains an abundance of information about the program, including pointers to important data structures stored elsewhere in the .EXE file. One of the structures referenced in the NE header is the *module reference table*, which

The .EXE File Headers

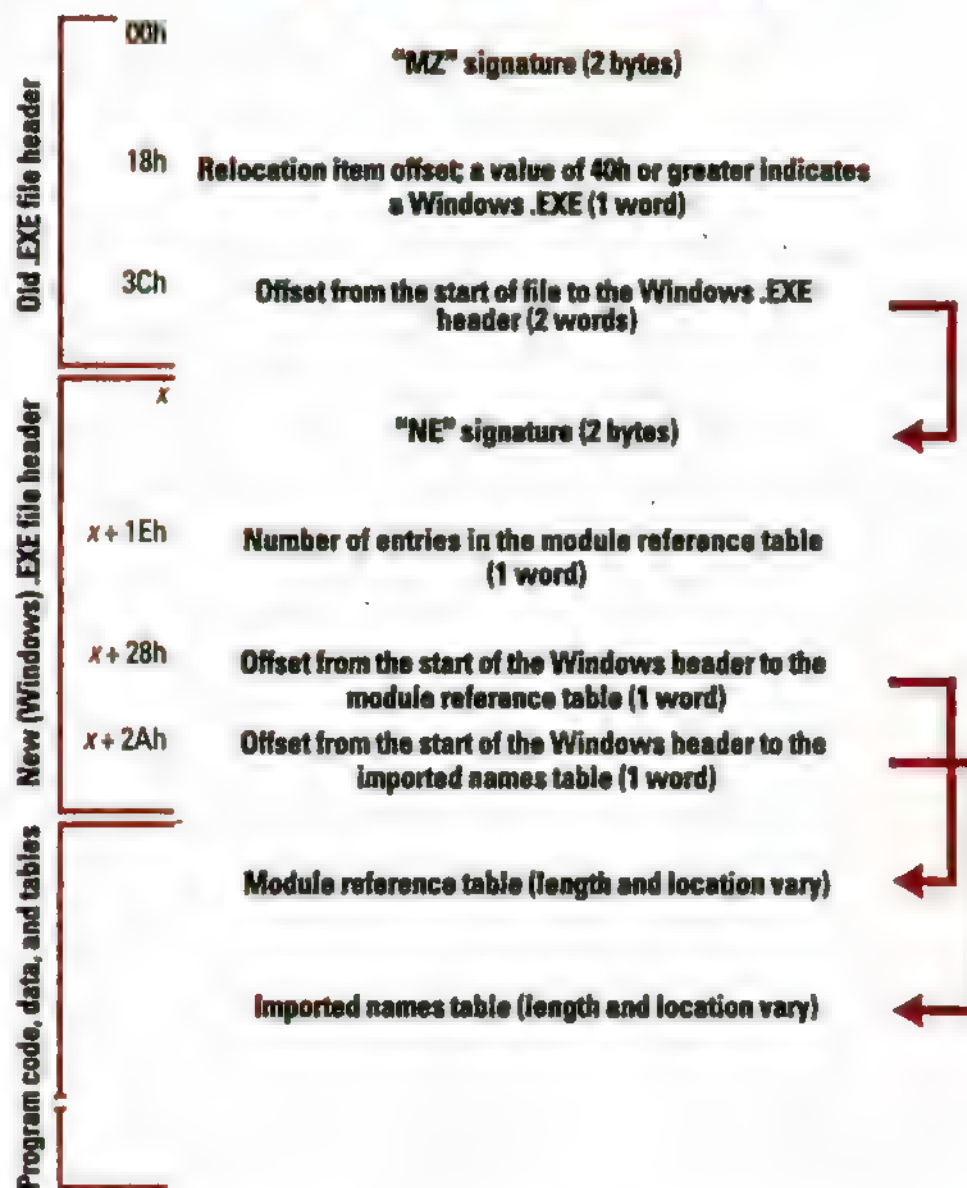


Figure 2: Using the two headers found in Windows executables, you can find the locations of the module reference table and the imported names table.

Static vs. Dynamic Linking

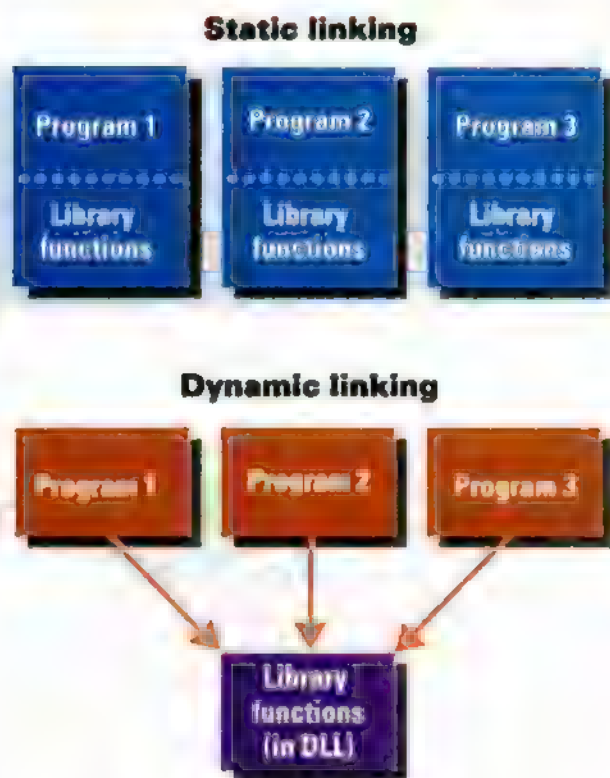


Figure 1: Because it lets all three programs share one library module, dynamic linking reduces memory requirements when three concurrently running programs access the same library functions.

identifies the modules (or DLLs) that the program requires. Each 2-byte entry in the module reference table specifies the offset of a module name in another table called the *imported names table*. In the imported names table, a module name consists of a count byte followed by one or more characters of ASCII text that spell out the name of the DLL. The count byte specifies the number of characters in the module name. The number of entries in the module reference table is specified at offset 1Eh in the NE header.

What all this means, of course, is that you can determine what DLLs a program requires by inspecting the .EXE file. This is easier said than done, because the module reference table and imported names table appear at different locations in just about every executable file. The procedure for enumerating the module names embedded in an .EXE file are explained in the sidebar, "Determining the Required DLLs."

If you don't want to know about all the programming procedures involved but just want to find out what DLLs a Windows program requires, use the DEBUG

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script in Figure 3, which creates a utility named **REQUIRES.COM**. You can obtain this script from the Utilities/Tips Forum of PC MagNet. Look in the Tutor section for the file **REQUIR.ZIP**. (If you type in the script, you can omit the comments in the right margin—the text following the semicolons.) This utility reads a Windows .EXE file header, module reference table, and imported names table and makes a list of all the module names

referenced. For example, typing

```
REQUIRES CLOCK.EXE
```

to list the modules required by Windows 3.1's Clock program produces the following output:

```
Modules referenced:
```

```
KERNEL
```

```
GDI
USER
COMMDLG
SHELL
```

CLOCK.EXE requires five DLLs in order to run: **KERNEL**, **GDI**, **USER**, **COMMDLG**, and **SHELL**. In most cases, a DLL's filename and module name are the same. The DLL file that corresponds to the module name **GDI**, for example, is

Assembly Code for **REQUIRES.COM**

Complete Listing

```
A 100
JMP 0189
DB "Syntax: REQUIRES filename$"
DB "File not found$"
DB "Not a Windows executable$"
DB "No modules referenced$"
DB "Modules referenced:",0D,0A,0D,0A,"$"
DB " $"
DB 0D,0A,"$"
DW 0,0,0,0,0,0,0,0
CLD
MOV SI,0081
LODSB
CMP AL,20
JZ 018D
CMP AL,09
JZ 018D
CMP AL,0D
JNZ 01A6
MOV DX,0103
MOV AH,09
INT 21
MOV AX,4C01
INT 21
MOV DX,SI
DEC DX
LODSB
CMP AL,20
JZ 01B6
CMP AL,09
JZ 01B6
CMP AL,0D
JNZ 01A9
MOV BYTE PTR [SI-01],00
XOR AX,AX
MOV DI,06DB
MOV CX,0020
REPZ STOSW
MOV AX,3D00
INT 21
MOV DX,011D
JB 019D
MOV [0179],AX
MOV AH,3F
MOV BX,[0179]
MOV CX,0040
MOV DX,06DB
INT 21
MOV DX,012C
CMP WORD PTR [06DB],5A4D
JNZ 019D
CMP WORD PTR [06F3],+40
JB 019D
MOV AX,4200
MOV BX,[0179]
MOV DX,[0717]
MOV [017B],DX
MOV CX,[0719]
MOV [017D],CX
INT 21
MOV AH,3F
MOV BX,[0179]
MOV CX,002C
MOV DX,06DB
INT 21
MOV AX,[06F9]
OR AX,AX
JNZ 0225
MOV DX,0145
JMP 019D
CMP AX,0200
JBE 022D

MOV AX,0200
MOV [0187],AX
XOR DX,DX
MOV AX,[0703]
ADD AX,[017B]
ADC DX,[017D]
MOV [017F],AX
MOV [0181],DX
XOR DX,DX
MOV AX,[0705]
ADD AX,[017B]
ADC DX,[017D]
MOV [0183],AX
MOV [0185],DX
MOV AX,4200
MOV BX,[0179]
MOV DX,[017F]
MOV CX,[0181]
INT 21
MOV AH,3F
MOV BX,[0179]
MOV CX,[0187]
SHL CX,1
MOV DX,02DB
INT 21
MOV AX,4200
MOV BX,[0179]
MOV DX,[0183]
MOV CX,[0185]
INT 21
MOV AH,3F
MOV BX,[0179]
MOV CX,F000
MOV DX,06DB
INT 21
MOV AH,3E
MOV BX,[0179]
INT 21
MOV AH,09
MOV DX,015B
INT 21
MOV CX,[0187]
MOV SI,02DB
PUSH CX
LODSW
MOV BX,AX
ADD BX,06DB
table
MOV AH,09
MOV DX,0173
INT 21
MOV CL,[BX]
XOR CH,CH
INC BX
MOV DL,[BX]
INC BX
MOV AH,02
INT 21
LOOP 02C3
MOV AH,09
MOV DX,0176
INT 21
POP CX
LOOP 02AF
MOV AX,4C00
INT 21

N REQUIRES.COM
RCX
IDB
W
Q
```

Figure 3: This assembly language program produces **REQUIRES.COM**, a utility that finds out what DLLs a Windows program requires.



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■ Determining the Required DLLs

To find out what DLL modules a Windows program requires, follow these steps:

1. Read the first 40h (64) bytes of the .EXE file into memory and inspect the bytes at offsets 00h and 01h. If these bytes do not hold the values 4Dh and 5Ah (the ASCII codes for M and Z, respectively), then stop right now because this is not a valid .EXE file.

2. Inspect the word (or 2-byte) value at offset 18h of the .EXE file. If the value is less than 40h, then stop because this is an old-style (DOS) .EXE file, not a Windows .EXE file. Windows .EXE files contain a lot of information that DOS .EXE files do not. (DOS .EXE files are often referred to as *old* executables, while Windows .EXE files are referred to as *new* executables.) If the value at offset 18h is 40h or greater, then the double word (4 bytes) at offset 3Ch

specifies the offset from the beginning of the file where the Windows header starts.

3. Read the first 2Ch (44) bytes of the Windows header from the file, using the file offset obtained in step 2 as the starting point. (For an added degree of stability, your program could verify that the file is a valid Windows .EXE file by making sure that the first 2 bytes in the Windows header hold the ASCII codes for the letters N and E. But at this point it would be highly unlikely for the file not to be a Windows program.) The word at offset 1Eh in the Windows header specifies the number of entries in the module reference table—in effect, the number of different modules that the program references. Save this value to use as a count later on, or exit now if the entry count is 0 (indicating that the program references no DLLs). The word at offset

28h in the Windows header specifies the offset (relative to the beginning of the Windows header) of the module reference table. The word at offset 2Ah specifies the offset (again relative to the beginning of the Windows header) of the imported names table. Use these offsets to read the module reference table and imported names table into memory.

4. We now have the three pieces of information that we need in order to enumerate the module names: the module reference table, the module reference table entry count, and the imported names table. If the entry count is equal to n , read n entries from the module reference table. Using each entry as an offset into the imported names table, read a module name from the imported names table and output it. When n entries have been processed, the enumeration is complete.

GDI.EXE and can be found in the Windows system directory. KERNEL, however, is an exception. If Windows is running in 386 Enhanced mode, the KERNEL file is KRNL386.EXE; in Standard mode, it's KRNL286.EXE. Almost every Windows program requires KERNEL, GDI, and USER. Most nonsystem DLLs (unlike KERNEL, GDI, and USER) carry the extension .DLL. Check the Windows system directory and you should find COMMDLG.DLL and SHELL.DLL, the DLLs referenced by Clock that correspond to the module names COMMDLG and SHELL.

You can even run REQUIRES on DLLs. For example, REQUIRES reports the following module references in USER.EXE:

Modules referenced:

```
KERNEL
GDI
SYSTEM
KEYBOARD
MOUSE
DISPLAY
```

```
SOUND
COMM
```

In addition to KERNEL and GDI, USER also calls the modules SYSTEM, KEYBOARD, MOUSE, DISPLAY, SOUND, and COMM, which are housed in the files SYSTEM.DRV, KEYBOARD.DRV, MOUSE.DRV, DISPLAY.DRV, SOUND.DRV, and COMM.DRV. (Yes, Windows.DRV files are actually DLLs.) Type REQUIRES KEYBOARD.DRV and you'll find that KEYBOARD.DRV uses functions inside KERNEL. It's not uncommon for one DLL to call functions from another. KRNL386.EXE is one example of a DLL that calls no other DLLs. REQUIRES reports "No modules referenced" for KRNL386.EXE, indicating that its module reference table is empty.

Before you run a program, you can use REQUIRES to determine what DLLs a program needs. It can also come in handy when you want to remove a Windows program from your hard disk. If a program installed some private DLLs in your Windows or Windows system directory, you'll

want to delete those DLLs to free up disk space. Without a utility like REQUIRES, it's difficult to tell which, if any DLLs a program uses. Before deleting a DLL from your hard disk, save a backup copy to a floppy disk just in case—unknown to you—another program uses the same DLL. You should not delete KERNEL, GDI, USER, and other modules that are part of Windows. In Windows 3.1, DLLs that are part of Windows are stamped with the date 3-10-92 and the time 3:10a, so they are rather easy to identify.

One caveat that you should be aware of concerning REQUIRES is that some Windows programs call DLLs that are not listed in their .EXE files. They do this by loading the DLLs themselves using Windows' LoadLibrary function and calling the functions after using Windows' GetProcAddress function to get the functions' addresses. Therefore, you may encounter some programs that need DLLs not listed by REQUIRES. For the majority of Windows apps, however, REQUIRES offers a safe and reliable way to determine intermodule dependencies. □

Extending Your Apps

BY SCOTT KRUEGER

Phone Home from WinWord

You might think that the programming language in your Windows word processor or spreadsheet is pretty powerful. But what happens when that programming environment runs out of steam? What if you can't write a program to do what you want your system to do? One alternative is to use your programming environment to make calls directly to the Windows application programming interface (API).

In this column, we'll show you how the Windows API gives you access to services that might not be part of your program's development environment. In our example, we'll build a macro for Microsoft Word for Windows called DialIt, which uses a few of the Windows communications APIs to dial the phone from within the word processor. Using Windows API functions is just a matter of understanding the calling conventions used by the three libraries that make up the Windows operating environment: KERNEL, USER, and GDI. Most Windows applications that include a macro language—word processors, spreadsheets, and databases—already have a built-in method to access Windows API functions, and you can readily modify this macro code to work with any Windows application that can read highlighted text and call Windows API functions.

API, PHONE HOME When you use a communications application to dial the phone, you're actually sending codes to the modem, although most application programs hide the modem interaction from you. For instance, when you tell the Windows Terminal program to dial the number 1-800-555-1212, Terminal sends the string ATDT1-800-555-1212 to the

modem. The ATDT code tells the modem to pick up the phone and dial the numbers that follow, using Touch-tones. To make Word for Windows dial the phone, you need to send the same information to the modem from within WinWord.

While Word for Windows doesn't have a built-in command to dial the telephone, its built-in WordBasic macro language lets you access the same services that Windows-based communications programs use. Although a full communications application would be very complex—and beyond the scope of this article—your code need contain only a few API calls to dial the phone.

To access Windows API functions from WordBasic, you'll need to use WordBasic's Declare statement to tell WinWord some basic information about the code you want to call. The declaration specifies the name of the function, the dynamic link library (DLL) where it resides, and any arguments the function takes. Note that Declare statements can be quite long, and it's common to use a backslash followed by a CR/LF (carriage return/line-feed) combination to break a statement into more than one line. The declaration takes the following form:

```
Declare Function FunctionName \
Lib LibName$([ArgumentList]) \
As Type
```

FunctionName is the name of the function used in the DLL (in this case, Open-

Comm). LibName\$ is the name of the library (for example, USER). ArgumentList consists of comma-separated placeholders for the data to be sent to the function, followed by the type. For example, cbInQueue As Integer, would hold space for the variable cbInQueue and expect an integer value. The four types that WordBasic understands are Integer, String, Long, and Double. If the variable name includes a \$, the "As String" type is assumed. If the Declare is for a function, the end of the statement describes the return value's type. A subroutine declaration contains the same elements as a function declaration but does not contain a return type:

```
Declare Sub SubName Lib
LibName$([ArgumentList])
```

To dial the telephone from WordBasic, you'll need three API commands: OpenComm(), WriteComm(), and CloseComm(). These three commands live in

.....
*Here, we'll show you how
the Windows API gives
you access to services that
might not be part of your
program's development
environment.*
.....

the USER library. For more information on the API functions available in Windows, see the five-volume Windows Software Development Kit (SDK) or one of the smaller texts on the Windows API. For more information on calling API functions from Windows applications, check out

Windows 3.1 Programming for Mere Mortals by Woody Leonhard (Addison-Wesley, 1992).

CREATING THE MACRO To create a new macro, select ToolsMacro from the Word for Windows menu and name the new macro DialIt. If you don't want to type in the macro code, you can download the file DIALIT.ZIP from PC MagNet's Programming Forum (see the sidebar "Guide to Our Utilities & How to Get Them" for more information).

Once you've named the macro, click on the Create button (or the Edit button if you're still using Version 2.0). This will open a macro window, with the standard Sub MAIN and End Sub commands visible. The complete macro code is shown in

DIALIT MACRO LISTING

Complete Listing

```

Declare Function OpenComm Lib "user" (lpDevControl$, \
    cbInQueue As Integer, cbOutQueue As Integer) As Integer
Declare Function WriteComm Lib "user" (idComDev As Integer, \
    lpvBuf$, cbWrite As Integer) As Integer
Declare Sub CloseComm Lib "user" (idComDev As Integer)

Sub MAIN
    CRLF$ = Chr$(13) + Chr$(10)
    PORT$ = "COM1"
    DIAL$ = "ATDT"
    Num$ = SelectNum$
    If InStr(Num$, Chr$(13)) Then Num$ = Left$(Num$, InStr(Num$, Chr$(13)) - 1)
    On Error Goto done : Num$ = InputBox$("Number to Dial", "Dial", Num$)
    idComDev = OpenComm(PORT$, 128, 128)
    REM check for error
    REM opening comm port
    If idComDev < 0 Then
        If idComDev = -2 Then
            MsgBox PORT$ + " is currently in use.", "Error"
        Else
            MsgBox "Error Opening " + PORT$, "Error = " + Str$(idComDev)
        End If
        Goto done
    End If
    REM dial the number
    result = WriteComm(idComDev, Dial$ + Num$ + CRLF$, Len(Dial$ + Num$ + CRLF$))
    MsgBox "Calling " + Num$ + Chr$(13) + "Pick up the phone.", "Dialit"
    REM Send CRLF to modem to HangUp modem
    result = WriteComm(idComDev, CRLF$ + CRLF$, Len(CRLF$ + CRLF$))
    CloseComm(idComDev)
    Done:
End Sub

Function SelectNum$
    REM Selection$() returns a string of the current Selection
    REM if the Length of the selection is < 3 then we try to select a #
    If Len(Selection$) < 3 Then
        REM SelInfo(12) returns -1 if we are in a table
        If SelInfo(12) = -1 Then
            REM In a Table
            REM Selecting to the end of the line includes the table
            REM marker, which doesn't give us the number, so go to
            REM end of line and select backwards
            EndOfLine = StartOfLine 1 : Num$ = Selection$()
        Else
            REM Select to the next paragraph mark
            ExtendSelection Chr$(13) : CharLeft 1, 1
            ParaSel$ = Selection$() : Cancel
            If Len(Selection$) > 2 Then CharLeft 0, UnSelect it
            REM Select to the next space
            ExtendSelection " "
            If Len(Selection$) > 2 Then CharLeft 1, 1
            SpaceSel$ = Selection$()
            Cancel
            If Len(Selection$) > 2 Then CharLeft 0, UnSelect it
            REM If Selection to a Para mark is shorter than selection
            REM to a space, use Selection to a Para mark else use
            REM Selection to a space
            If Len(ParaSel$) < Len(SpaceSel$) And Len(ParaSel$) <> 2 Then
                Num$ = ParaSel$
            ElseIf Len(SpaceSel$) = 1 Then
                Num$ = ParaSel$
            Else
                Num$ = SpaceSel$
            End If
        End If
    Else
        REM Original Selection was not less than 3 character in len, so
        REM use whatever is selected
        Num$ = Selection$()
    End If
    REM UCase of a Number is a number, so if
    REM UCase of selection <> selection
    REM then not a number
    If UCase$(Num$) <> Num$ Then Num$ = ""
    SelectNum$ = Num$
End Function

```



Figure 1: This Word for Windows macro uses Windows communications APIs to dial the phone from within a word processor.

Figure 1. I'll explain things as we go through it, line by line.

With WordBasic, Declare statements normally go before the Sub MAIN, so move the flashing insertion point to the beginning of the window and type in the following Declare statements:

```

Declare Function OpenComm\
Lib "user" (lpDevControl\
cbInQueue As Integer,\
cbOutQueue As Integer)\
As Integer
Declare Function WriteComm\
Lib "user" (idComDev As \
Integer, lpvBuf$, cbWrite\
As Integer) As Integer
Declare Sub CloseComm Lib\
"user" (idComDev As \
Integer)

```

Now let's work on the body of the macro. First, you'll need to send a CR/LF to the modem at the end of each line sent. In WordBasic, that's represented as

```
CRLF$=Chr$(13)+Chr$(10)
```

Next, the macro assumes that your modem is connected to the COM1 port.

Change this line to match your modem setup:

```
PORT$="COM1"
```

A standard Hayes-compatible modem sends the code ATDT to tell the modem to dial the numbers that follow. In our macro, let's assign that code to the variable DIAL\$:

```
DIAL$="ATDT"
```

If your modem requires a different dial string, change the value of DIAL\$. The macro also needs to know what number to dial. I've added a function called SelectNum\$() at the end of the macro that checks for a highlighted number. If it can't find one, it searches for a number in the current line or table cell. While I could have used the built-in Selection\$() function to use whatever number is highlighted on the screen, the SelectNum\$() function makes things a little easier by finding the number if you forget to highlight it.

An extra carriage return sent to the modem tells it to cancel dialing. Since we'll be adding our own CR/LF to the end of the dial string, it's important to make

sure that the selected number doesn't include an extra carriage return. The following statement removes any carriage return at the end of the highlighted text:

```

If InStr(Num$, Chr$(13)) \
Then Num$ = Left$(Num$, \
InStr(Num$, Chr$(13))- 1)

```

Let's move on to the confirmation dialog box. WordBasic has a standard dialog box called with the InputBox\$() statement that presents information to the user and lets him change it. Although this method has some limitations, we'll opt for simplicity and reliability over elegance:

```

On Error Goto done:Num$= \
InputBox$("Number to "+ \
"Dial", "Dial", Num$)

```

The On Error statement tells the dialog to go to the label "done:" if you press the Esc key or the CANCEL button. The rest of the line tells the macro to use an InputBox\$() to present the dialog with the instructions "Number to Dial", the title "Dial", and the selected text variable Num\$ in a text box that you can change. Lots of mileage from one line.

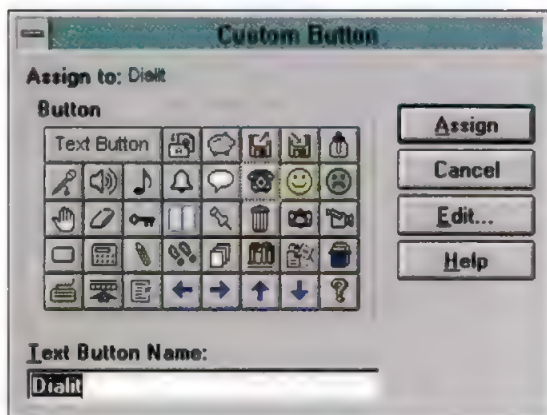


Figure 2: For WinWord 6.0 users, choose a button face to assign to the macro with this Custom Button dialog box.

IF I COULD TALK TO THE MODEM We're finally ready to talk to the modem using the OpenComm API function:

```
idComDev= OpenComm(Port$,128, 128)
```

The syntax for the OpenComm command requires the name of the port and the sizes of the input and output buffer (areas of memory set aside to hold data going into and out of the modem). Since we'll be using fairly small strings, we can use small buffers—say, 128 characters.

When DialIt calls the OpenComm function, Windows returns a value that is either an identifier for the open communications channel to the port (which we'll need in a moment) or an error code less than 0. If the error code is -2, for example, then the port is currently in use. If we get a code less than 0, we'll use a message box to tell us we had an error. The following MsgBox function also puts a string representation of the error code in the title, in case someone really wants to know what the error was.

```
REM check for error
REM opening comm port
If idComDev < 0 Then
If idComDev=-2 Then
MsgBox Port$ + " is "+\
"currently in use." \
, "Error"
Else
Msgbox "Error Opening "+\
Port$, "Error = " + \
Str$(idComDev)
End If
Goto done
End If
```

Next the macro sends the dialing string to the modem, using the WriteComm API function. The WriteComm function needs comm port identification (idComDev), the string to send, and the length of the string:

```
result=WriteComm(idComDev,\
Dial$ + Num$ + CRLF$,\
Len(Dial$+ Num$ + CRLF$))
```

Once the number has been dialed, the macro needs to disconnect the modem so that you can get on with your conversa-

tion. The macro should be polite enough, however, to wait until after you pick up the telephone. Displaying a message box pauses the macro until you pick up the phone and click the OK button, as follows:

```
MsgBox "Calling " + Num$+\
Chr$(13)+"Pick up the "+\
"phone.", "DialIt"
```

When you click on the OK button, the macro sends two carriage return/line-feed combinations to the modem to tell it to hang up:

```
result = WriteComm(\
idComDev,CRLF$+CRLF$,\
Len(CRLF$+CRLF$))
```

Finally, the macro closes the connection to the modem using the CloseComm() API:

```
CloseComm(idComDev)
```

That's it. Click File, then Close. Answer Yes if you're prompted to save changes to the macro. DialIt is now ready to roll.

THE FINISHING TOUCHES As a finishing flourish, assign DialIt to a button on the toolbar, so it's always handy. In WinWord 6.0, select Tools/Customize. Scroll the categories list box until you see Macros and click on it, then select DialIt from the Macros list box. Click and hold the left mouse button and drag the name to the toolbar and position it where you want the button to appear. After you have

dragged the macro name to the toolbar, a blank button appears at the selected location, and the Custom Button dialog appears (Figure 2), letting you select an image for the button face.

For WinWord 2.0, click on Tools/Options. Scroll to the icon for toolbar in the list box. In the Tool to Change box, select an open "[space]" to fill in with your own button for DialIt. Choose a button and select the macro name DialIt. Hit the Change button and then the Close button to display the button on the toolbar.

Take DialIt for a test drive by opening a new WinWord document. Type in a phone number, highlight it, and then hit the toolbar button. There's one nice feature already built into the DialIt code: If the number you want to dial is handy, and you don't want to create a new document

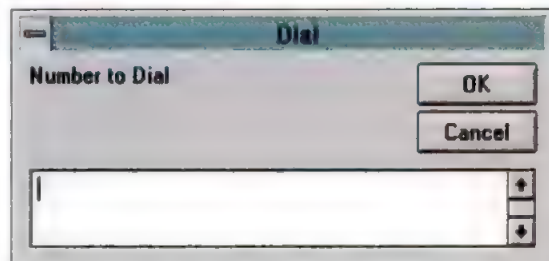


Figure 3: Launching the DialIt macro with no text highlighted displays the Dial dialog box and lets you enter a phone number to dial.

with the number, just hit the toolbar button anyway. If there is no selection and there isn't a number in the current line, the macro will present the DialIt dialog box (Figure 3). Just type the number to dial in the box and click OK.

CONCLUSION Already a powerful programming environment, WordBasic has the ability to call Windows API functions, giving you even more latitude to broaden the potential for powerful applications. The DialIt macro is a simple example that only uses 3 of the more than 1,000 API function calls available in Windows. Often if what you want to accomplish isn't available within an application's programming language, you can do it via the Windows API—just one more way to extend the power of your applications. □

SCOTT KRUEGER IS A LONGTIME WORDBASIC MAVEN. HE IS CURRENTLY WRITING *THE HACKER'S GUIDE FOR WORD FOR WINDOWS 6.0*, TO BE PUBLISHED IN THE SUMMER OF 1994.

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CP lets your programs list the contents of .ARJ, .LHA, and .ZIP archives, create and decompress .ZIP files compatible with PKZIP 2.04G or PKZIP 1.10, and compress data internally to save memory and disk space. We looked at the Microsoft Visual Basic version; there is also a version for PowerBASIC 3.0 and another with support for a variety of DOS-based BASIC compilers (Microsoft BASIC 6.0, Microsoft Basic Professional Development System 7.x, Visual Basic for DOS, and QuickBASIC 4.00b and 4.5). Also available is a Windows DLL version for use with any language that lets you call DLL routines. Full source code is included for all but the lowest-level routines.

TYPES OF COMPRESSION Data-compression algorithms work by minimizing the number of bytes used to express the information in a file. Using the wrong algorithm for a given file, however, can actually result in a larger file. CP implements six general-purpose compression algorithms: Shrink, Implode, Deflate, Scrunch, Huffman, and Mash. These should compress most common files, but if the selected algorithm would result in a larger file, CP automatically stores the file unchanged.

Shrink and Implode correspond di-

rectly to methods used by PKZIP 1.10, and Deflate matches the new method introduced with PKZIP 2.04G. Programs that use only these methods will produce files compatible with PKZIP. Depending on the type of file, however, other types of compression algorithms may work faster or compress more efficiently. If PKZIP compatibility isn't important, you may want to try one of these. Scrunch is fast and requires little overhead, Huffman is slow to compress but quick to decompress, and Mash is a variation of Huffman that compresses faster but less efficiently.

THREE GROUPS OF ROUTINES CP's routines are divided into three groups: user-level, low-level, and high-level. The low-level routines support the high-level and user-level routines and are not meant to be called directly. The high-level routines support the user-level routines, but your programs may occasionally call high-level routines. In general, however, all the routines you will need are user-level. These functions have been made as simple as possible, and include code to verify their parameters. For example, the user-level function that compresses a file takes as its parameters the .ZIP file's handle, a filename, and a set of switches defining (among other things) the compression method. If the parameters are valid, the user-level function calls a high-level routine that compresses data from one open file handle to another. That function in turn calls a low-level routine to apply a specific compression algorithm.

CP's user-level compression and decompression functions can add or delete files from an archive, display or change

comment strings for individual files or for the whole archive, and store directory information along with files. The Visual Basic version (not DOS versions) can also freshen or update an archive, select files based on file attributes, and preserve the archive's date/time stamp. The only remaining function of PKZIP 2.04G that can't be easily added by the programmer is support for PKZIP archives spanning multiple disks. CP can compress and decompress multi-disk archives, but the format it uses for such files is not compatible with PKZIP.

One of three sets of user-level routines is called automatically to report on the progress of compression and decompression. CP supplies files containing three different versions of these routines. One of these gives a text-based list display; another gives you a standard percent-complete display. By changing one function, you can create a customized progress display. Other routines compress specified areas of memory, variable-length strings, and (with some limitations) arrays.

To incorporate CP into a Visual Basic program, you simply add COMPRESS.BAS and VIEWZIP.BAS to the project, along with a module containing the progress-reporting functions. These files contain declarations for the low-level routines in the CP DLL, along with the source code for the user-level and high-level routines.

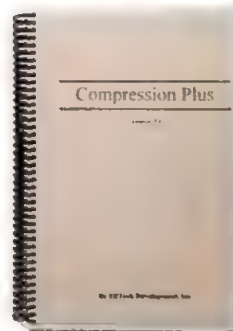
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Environments

BY CHARLES PETZOLD

Paths, Regions, and Clipping

Anyone familiar with a number of graphics programming environments has probably come to the conclusion that we don't really know yet how best to describe visual information. For example, most modern graphics systems support both raster graphics (the representation of real-world information using bitmaps) and vector graphics (the construction of images using lines, filled areas, and text), but there is often little overlap or harmony between these two extremes. And within these two areas, every graphics system has its own unique features and quirks.

As we've seen in the past several issues, even working with something as seemingly simple as lines is not so simple after all. Windows NT has some new features added to the Windows Graphics Device Interface (GDI)—namely wide lines and paths—that make it more versatile than the DOS-based version of Windows and also more complex. Let's take a moment to review.

A path is a collection of straight line and curve definitions stored in GDI and associated with a particular device context. You create a path by calling `BeginPath`, then calling line-drawing functions, and finally calling `EndPath`.

A path is composed of subpaths. Each subpath is a series of *connected* straight lines and curves. Subpaths can be either open or closed. In a closed subpath, the end of the last line in the subpath meets up with the beginning of the first line in the subpath, accomplished by a call to the `CloseFigure` function.

In the last issue, I showed how to render the path as a series of lines by calling `StrokePath`, how to fill all enclosed areas

of the path with a pattern by calling `FillPath`, and how to do both at once with a call to `StrokeAndFillPath`.

THE ELUSIVE REGION One path function I didn't discuss last time is `PathToRegion`, which converts the path into a GDI region. Regions have been a part of GDI since Windows 1.0 and were inspired by a similar feature in the Macintosh QuickDraw system. Yet they have remained perhaps the least understood and utilized feature of GDI. I mentioned earlier that a path is a collection of straight lines and curves, which could define enclosed areas. A region describes areas that are initially defined by a series of connected lines. As we'll see, this distinction results in some significant differences when paths and regions are rendered.

In the DOS-based Windows 3.1, you can create a region with a call to one of seven functions—`CreateRectRgn`, `CreateRectRgnIndirect`, `CreateEllipticRgn`, `CreateEllipticRgnIndirect`, `CreateRoundRectRgn`, `CreatePolygonRgn`, and `CreatePolyPolygonRgn`. Each of these functions returns a handle to the region. The region describes the enclosed area of a rectangle, ellipse, rounded rectangle, or one or more polygons. You can create multiple regions if you'd like and combine them with `CombineRgn`. Other functions let you manipulate regions in various ways.

You can render a region on the display by using the functions `FillRgn`, `PaintRgn`, `FrameRgn`, and `InvertRgn`. The `FillRgn` and `PaintRgn` functions both fill a region

with a pattern. The difference is that `FillRgn` takes a brush handle as a parameter, while `PaintRgn` uses the brush currently selected in the device context. `FrameRgn` outlines the boundaries of a region with a line.

So we see that paths and regions at first seem to be very similar. The `PaintRgn` function is like the `FillPath` function, while the `FrameRgn` function is like the `StrokePath` function. With help from the `ExtCreatePen` function in Windows NT, the line that you use to stroke a path can be a wide brush pattern. Interestingly enough, the `FrameRgn` function also outlines the boundaries of a region with a brush pattern of a specific height and width.

THE PATH AND REGION CONNECTION

The path and region connection is very simple: You can convert a path into a region by calling

```
hRgn = PathToRegion (hdc) ;
```

This function closes all open paths, turns the interiors into a region, destroys the path definition, and returns a handle to the re-

Regions have been part of GDI since Windows 1.0, yet they remain the least understood and utilized of its features.

gion. (The region itself must later be destroyed with a call to `DeleteObject`.)

The question now is, if you call `StrokeAndFillPath` after creating a path, do you get the same results by converting the path to a region and calling `PaintRgn` (or `FillRgn`) and `FrameRgn`? The

answer, in the general case, is no. Let's look at an example. The `PATHRGN` program is shown in Figure 1. It requires the NTGDI files presented in the Environments column of January 11, 1994. You can download all the files, including the executables, from PC MagNet's Programming Forum archived as `PATHRG.ZIP`.

The program draws six five-pointed stars in two rows of three each. Five-pointed stars are typically used to demonstrate the difference between alternate and winding area-filling modes. The `PATHRGN` program sets the alternate mode for the top row of three stars and the winding mode for the bottom row. For each star, the program creates a closed path based on the five points of the star.

Complete Listing

```

    pt[2 * i % 5].x = (2 * x + 1) * cxArea / 6 +
        (INT) (cxArea * .150 * cos (TWOPI * iAngle / 360)) ;

    pt[2 * i % 5].y = (2 * y + 1) * cyArea / 4 +
        (INT) (cyArea * .225 * sin (TWOPI * iAngle / 360)) ;
}

// Create the path

BeginPath (hdc) ;
MoveToEx (hdc, pt[0].x, pt[0].y, NULL) ;
PolylineTo (hdc, pt + 1, 4) ;
CloseFigure (hdc) ;
EndPath (hdc) ;

// Render the path

switch (x)
{
    case 0:
        SelectObject (hdc, GetStockObject (BLACK_PEN)) ;
        StrokePath (hdc) ;
        break ;

    case 1:
        SelectObject (hdc, hPenBlue) ;
        SelectObject (hdc, hBrushRed) ;
        StrokeAndFillPath (hdc) ;
        break ;

    case 2:
        hRgn = PathToRegion (hdc) ;

        FillRgn (hdc, hRgn, hBrushRed) ;
        FrameRgn (hdc, hRgn, hBrushBlue, 5, 5) ;

        DeleteObject (hRgn) ;
        break ;
}

}

SelectObject (hdc, GetStockObject (BLACK_PEN)) ;
SelectObject (hdc, GetStockObject (WHITE_BRUSH)) ;

Select (hBrushRed) ;
Select (hBrushBlue) ;
Select (hPenBlue) ;

```

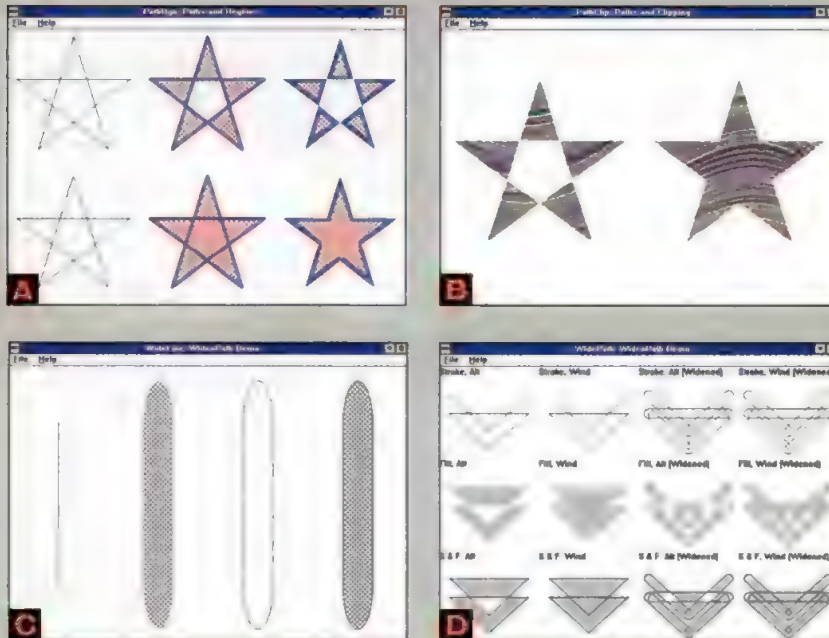


For the third star in each row, the program converts the path to a region. The program calls `FillRgn` using a red patterned brush and `FrameRgn` with a solid blue brush, specifying a 5-pixel width in the `FrameRgn` function. The region is then deleted. The stars in the second and third rows are different, as shown in screenshot A in the sidebar “The Intricate Relationships.”

The second and third stars in the top row (the alternate fill-mode row) are more similar to each other than those in the bottom row, but there is still a difference. As the path is converted to a region,

The problem turned out to involve transforms. There's always been some confusion about whether regions were defined in device units (pixels) or logical units. The

The Intricate Relationships



The PATHRGN display (A) shows the difference between paths and regions. The PATHCLIP display (B) shows two paths combined into a single clipping area. The WIDELINE display (C) demonstrates a useful application of the WidenPath function. The WIDEPATH display (D) illustrates the effect of WidenPath on the other path functions.

actual answer is neither. Take a close look at the CreateRectIndirect function:

```
hRgn = CreateRectIndirect (& rect);
```

The single parameter is a pointer to a rectangle structure. There is no handle to a device context. Although the region is a GDI object, it is not associated with a device context; hence, the coordinates that define the region are just units that mean

nothing by themselves. Everything depends on how the units are interpreted by the region rendering functions.

Here's where the confusion begins: The *Programmer's Reference* of the Windows 3.1 Software Development Kit states for FillRgn and FrameRgn, "The coordinates for the given region are specified in device units." This is simply not true. These functions (and the other region rendering functions) assume that the region units are logi-

cal coordinates. (*Microsoft Win32 Programmer's Reference* finally gets it right.)

So if region coordinates themselves are independent of any device context, how does GDI handle the PathToRegion function? After all, the path is associated with a device context, and there may be a transform in effect. Hold onto your hats. Things are going to get hairy.

We all know that the coordinates passed to line-drawing functions (whether normally or inside a path bracket) are always logical coordinates. When you call these functions normally, GDI must convert the logical coordinates to device coordinates (pixels) for rendering on the display. When you call line-drawing functions in a path, GDI has a choice. It can convert the logical coordinates to device coordinates either as the path is being created or later when the path is rendered. My experimentation shows that GDI takes the first approach.

That is, GDI stores a path definition in device coordinates. Functions such as StrokePath and FillPath use these device units directly. If you change a mapping mode or transform after the path has been created but before it is rendered, the change will have no effect on the path itself (although it will affect pen widths). The rule is to set the proper mapping mode or transform *before* you create the path, not afterwards.

This implementation detail does not bode well for the PathToRegion function. Let's assume you define a transform so that logical coordinates are 5 times device coordinates. (I'll show you how to do this shortly.) Mathematically, GDI performs the following calculations when converting points you pass to GDI functions to

PATHRGN2.C Complete Listing

```

/******
PATHRGN2.C BD Paths and Regions
(c) Charles Petzold, 1994
*****

#include <windows.h>

char szClass [] = "PathRgn20";
char szTitle [] = "PathRgn2: Paths and Regions0";

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
{
    HRGN hRgn;
    SIZE size;

    // Set logical coordinates to 5 times device coordinates
    SetMapMode (hdc, MM_ANISOTROPIC);

    GetWindowExtEx (hdc, &size);
    SetWindowExtEx (hdc, 5 * size.cx, 5 * size.cy, NULL);

    // Create a 500-unit wide rectangle path and stroke it
    BeginPath (hdc);
    Rectangle (hdc, 500, 500, 1000, 1000);
    EndPath (hdc);

    StrokePath (hdc);

    // Create the same path, convert to region, and fill it
    BeginPath (hdc);
    Rectangle (hdc, 500, 500, 1000, 1000);
    EndPath (hdc);

    hRgn = PathToRegion (hdc);

    FillRgn (hdc, hRgn, GetStockObject (BLACK_BRUSH));

    DeleteObject (hRgn);
}

```

Figure 2: The PATHRGN2.C programs demonstrates the transform problem with PathToRgn.





20 years.

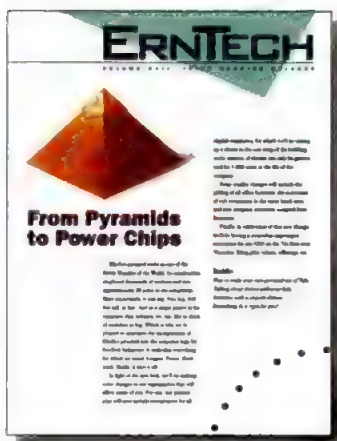
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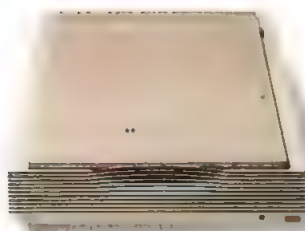
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PATHS AND CLIPPING We looked at StrokePath, FillPath, and StrokeAndFillPath in the last issue, and we've successfully conquered the PathToRegion function. You can also create a clipping area

Complete Listing



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Complete Listing

```

BeginPath (hdc) ;
MoveToEx (hdc, pt[0].x, pt[0].y, NULL) ;
PolylineTo (hdc, pt + 1, 4) ;
CloseFigure (hdc) ;
EndPath (hdc) ;

// Set clipping area

SelectClipPath (hdc, x ? RGN_OR : RGN_COPY) ;
}

// Draw Bezier splines

MapMode (hdc, MM_TEXT) ;
ViewportOrgEx (hdc, 0, 0, NULL) ;

fset = (cxArea + cyArea) / 4 ;

(y = -iOffset ; y < cyArea + iOffset ; y++)
{
    pt[0].x = 0 ;
    pt[0].y = y ;

    pt[1].x = cxArea / 3 ;
    pt[1].y = y + iOffset ;

    pt[2].x = 2 * cxArea / 3 ;
    pt[2].y = y - iOffset ;

    pt[3].x = cxArea ;
    pt[3].y = y ;

    SelectObject (hdc, CreatePen (PS_SOLID, 1,
        RGB (rand () % 256, rand () % 256, rand () % 256))) ;

    PolyBezier (hdc, pt, 4) ;

    DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN))) ;
}

```



Complete Listing

```

case 2:
    SelectObject (hdc,
        ExtCreatePen (PS_GEOMETRIC | PS_SOLID,
            30, &lb, 0, NULL)) ;

    BeginPath (hdc) ;

    MoveToEx (hdc, 50, 20, NULL) ;
    LineTo (hdc, 50, 80) ;

    EndPath (hdc) ;

    WidenPath (hdc) ;

    DeleteObject (
        SelectObject (hdc, GetStockObject (BLACK_PEN))) ;

    StrokePath (hdc) ;
    break ;

case 3:
    SelectObject (hdc,
        ExtCreatePen (PS_GEOMETRIC | PS_SOLID,
            30, &lb, 0, NULL)) ;

    BeginPath (hdc) ;

    MoveToEx (hdc, 50, 20, NULL) ;
    LineTo (hdc, 50, 80) ;

    EndPath (hdc) ;

    WidenPath (hdc) ;

    DeleteObject (
        SelectObject (hdc, GetStockObject (BLACK_PEN))) ;

    SelectObject (hdc, CreateBrushIndirect (&lb)) ;

    StrokeAndFillPath (hdc) ;

    DeleteObject (
        SelectObject (hdc, GetStockObject (WHITE_BRUSH))) ;
    break ;

```



WIDEPATH.C

Complete Listing

```

/******
WIDEPATH.C DD WidenPath Demo
(c) Charles Petzold, 1994
******/

#include <windows.h>

char szClass [] = "WidenPath";
char szTitle [] = "WidenPath Demo";

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
{
    static char * szOper [] = { "Stroke", "Fill", "Stroke & Fill" };
    static char * szFill [] = { "Alt", "Wind" };
    static char * szWide [] = { "Wide", "Wide" };
    int x, y;

    // Define a logical display area
    SetMapMode (hdc, MM_ANISOTROPIC);
    SetWindowExtEx (hdc, 100, 100, NULL);
    SetViewportExtEx (hdc, cxArea / 4, cyArea / 3, NULL);

    // Set text alignment and brush
    SetTextAlign (hdc, TA_UPDATECP);
    SelectObject (hdc, GetStockObject (LTGRAY_BRUSH));

    for (x = 0; x < 4; x++)
        for (y = 0; y < 3; y++)
        {
            // Set the proper viewport origin
            SetViewportOrgEx (hdc, x * cxArea / 4,
                             y * cyArea / 3, NULL);

            // Display text descriptions
            MoveToEx (hdc, 0, 0, NULL);
            TextOut (hdc, 0, 0, szOper [y], strlen (szOper [y]));
            TextOut (hdc, 0, 0, szFill [x % 2], strlen (szFill [x % 2]));

            TextOut (hdc, 0, 0, szWide [x > 1], strlen (szWide [x > 1]));

            // Create a path with an open and closed subpath
            BeginPath (hdc);

            MoveToEx (hdc, 10, 30, NULL);
            LineTo (hdc, 50, 70);
            LineTo (hdc, 90, 30);

            MoveToEx (hdc, 10, 50, NULL);
            LineTo (hdc, 50, 90);
            LineTo (hdc, 90, 50);
            CloseFigure (hdc);

            EndPath (hdc);

            // Possibly widen the path by a 10 width pen
            if (x > 1)
            {
                SelectObject (hdc, CreatePen (PS_SOLID, 10, 0));
                WidenPath (hdc);
                DeleteObject (SelectObject (hdc, GetStockObject (BLACK_PEN)));
            }

            // Set polygon filling mode
            SetPolyFillMode (hdc, x % 2 ? WINDING : ALTERNATE);

            // Stroke, fill, or stroke and fill the path
            switch (y)
            {
                case 0: StrokePath (hdc); break;
                case 1: FillPath (hdc); break;
                case 2: StrokeAndFillPath (hdc); break;
            }
        }
}

```



Figure 6: The WIDEPATH.C program uses the WidenPath function in conjunction with other path functions.

using paths. A clipping area restricts drawing to the interior of the area. When you call `SelectClipPath`, all open paths are closed and the interiors either become the new clipping area or are combined in various ways with the existing clipping area. The syntax is

```
SelectClipPath (hdc, iOption);
```

Here are the five options available with the `SelectClipPath` function, and—using C syntax—how the path is combined with the existing clipping region to create a new clipping region.

```

iOption Result
RGN_ANDClipO = Clip & Path
RGN_COPY ClipO = Path
RGN_DIFF ClipO = Clip - Path
RGN_ORClipO = Clip | Path
RGN_XORClipO = Clip ^ Path

```

Before Windows NT, you set a clipping region using the `SelectClipRgn` function. Again we see another relationship among paths, regions and, clipping. Although the `SelectClipRgn` function does not allow the options shown above, the `CombineRgn`

function does. The `SelectClipRgn` function is still useful in Windows NT for removing the clipping region by passing a `NULL` handle for the region parameter:

```
SelectClipRgn (hdc, NULL);
```

The `SelectClipRgn` function assumes that the region was defined in device units (pixels), not logical units. That can be inconvenient at times. But get this: Windows NT allows you to define your clipping region in logical units using a path because, as I discussed above, GDI converts the logical units into device units at the time the path is being created. Thus, these device units are ready to be converted directly to a clipping region. The quirk that made `PathToRgn` awkward causes `SelectClipPath` to be convenient.

Let's look at some code. The `PATHCLIP` program, shown in Figure 4, sets an isotropic mapping mode and creates two paths containing a five-pointed star, one using alternate fill mode and the second using winding. For the first path, the program calls `SelectClipPath` using the `RGN_COPY` option. This makes the clipping area the interior of the path. The sec-

ond call to `SelectClipPath` uses `RGN_OR`, making the new clipping area the union of the existing clipping area and the interior of the new path. The program then draws a series of colored Bezier splines, which are restricted to the interiors of the stars, as shown in screenshot B in the sidebar. Such a figure would be difficult to create without the use of clipping.

You may feel inclined to create a single path with both star definitions and then call `SelectClipPath` with the `RGN_COPY` option. However, `SelectClipPath` uses the fill mode in effect at the time the function is called, so you wouldn't be able to mix alternate and winding filled figures.

The `PATHCLP2` program (not shown here but available from PC MagNet) is another version of this program that does not use `SelectClipPath` but instead converts each path to a region using `PathToRegion`, combines the regions with `CombineRgn`, and then calls `SelectClipRgn`.

WIDENING THE PATH I have one last path function to discuss. Your program may call this function after it's finished creating the path but before calling `StrokePath`, `FillPath`, `StrokeAndFillPath`, `PathToRegion`, or `SelectClipPath`:

WidenPath (hdc) ;

This is a peculiar function, and at first conceptually quite difficult. It replaces the existing path with a new path. The new path consists of the outline of the line that would be drawn if the path were stroked with the current pen. The "outline of the line"? Well, yes, because paths can be rendered with wide lines. The wide line is actually an area and has a boundary. That boundary is what replaces the existing path. Every open subpath becomes a closed subpath, and every closed subpath becomes two closed subpaths.

The WidenPath function actually has a useful application, as illustrated by the WIDELINE program shown in Figure 5. Refer to the results of this program, shown in screenshot C in the sidebar, as I discuss the code. The program draws four straight lines. The first is just a simple line using the default pen. The second is a wide line drawn with a pen 30 units wide using a hatch pattern. It works, of course, but it looks a little funny because the hatch pattern simply ends at the boundaries of the

wide line without any visual sense of enclosure. What we'd prefer would be a thin boundary around the hatch pattern.

This is accomplished through WidenPath. The third line in the WIDELINE display draws the same line but within a path bracket. The selected pen is the same pen as used in the second figure. After the path is completed, the program calls WidenPath and then strokes the path using the default (1 pixel wide) pen. What we get is a representation of the path as it now exists in memory—as the outline of the wide line.

The fourth line is where we put all this together to solve the problem: The code duplicates much of the code for the third line, but does not call StrokePath. Instead, it creates and selects a brush using the same hatch pattern. It then calls StrokeAndFillPath using the default pen and that pattern. Unlike the second line, the widened path is filled with the brush, allowing an outline to be drawn at the same time.

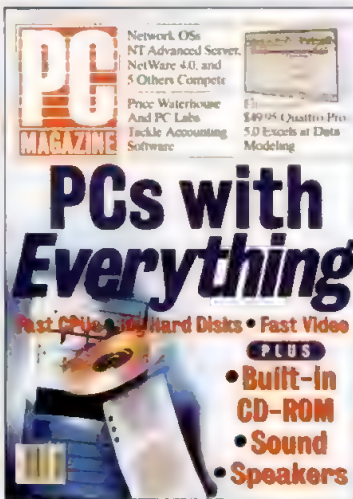
For anything other than single straight lines, however, WidenPath has a big, big problem. For polylines and curves, the al-

gorithm that the GDI developers have written for this function simply does not perform as you'd expect or hope. In short, the widened path often loops into its interior. Visually, it's a mess.

The WIDEPATH code shown in Figure 6 is similar to code I've written to demonstrate paths since the early OS/2 Presentation Manager days. It illustrates the problem that, by the way, also exists in OS/2. (One recent OS/2 version of this program can be found in the Environments column of May 25, 1993.)

The program renders the same figure—an overlapping V and a triangle—12 times using polylines, with combinations of stroking, filling (in both alternate and winding mode), and widening. All 12 figures are labeled in the window, as shown in screenshot D in the sidebar. As you can see, when the path is widened, the line joins have little unsightly loops inside the path (the problem is much worse for ellipses). This problem reduces the usefulness of WidenLine considerably.

In the next issue, we'll look at using paths with TrueType fonts. □



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Utilities

BY BOB FLANDERS AND MICHAEL HOLMES

PERUSE Your "Lost" Screen Data At Leisure

How many times have you executed a command under DOS, only to have the information you need scroll off the screen before you can read it? Inevitably, you rerun the command using DOS's MORE option (or the Pause key) to prevent the information from quickly departing into the ether.

PERUSE, a DOS TSR (terminate and stay resident) program, offers an interactive alternative. PERUSE captures display information as it leaves the screen and then lets you review previously displayed information whenever you need it. The saved information is always just a keystroke away.

PERUSE has the same basic features as an older *PC Magazine* utility (Wait-aSec, written by Charles Petzold back in 1985). But Wait-aSec, one of the magazine's most popular utilities, only works with EGA video adapters. PERUSE can handle VGA adapters and also takes advantage of extended or expanded memory to minimize conventional-memory usage.

You can obtain both the PERUSE program and its source code by downloading the file PERUSE.ZIP from either the Utilities/Tips Forum or the Programming Forum on PC MagNet. If you don't have a modem, you can obtain the files through the mail. For details, see the sidebar "Guide to Our Utilities & How to Use Them." To reassemble PERUSE from its source code, you will need either a Borland or a Microsoft assembler.

USING PERUSE As a prerequisite to using PERUSE, you must have an EMS (Expanded Memory Specification) or XMS (Extended Memory Specification) driver installed in your system. This gives your computer access to memory above the 640K barrier imposed by DOS and the PC architecture. PERUSE uses EMS or XMS memory for the buffer that holds the screen contents. The syntax for loading PERUSE is simple:

```
PERUSE /En I /Xn
```

The /E switch tells PERUSE to use expanded (EMS) memory; the /X switch says to use extended (XMS) memory. For both switches, replace *n* with the number of kilobytes of memory you want PE-

RUSE to use for its buffer. The minimum allowed value for *n* is 16; the maximum is 8,192. For example, to start PERUSE with a 150K buffer in expanded memory, enter the command

```
PERUSE /E150
```

The larger the buffer used, the more screen history PERUSE can store. PERUSE compresses the stored lines, so you can't tell just how many lines 150K can hold, but it's at least 960, since that's how many you could store uncompressed. (This is because 150K—or 153,600 bytes—can store 960 lines of 80 characters each when each character takes up 2 bytes.)

During its initialization, PERUSE checks to determine that the requested type of memory is available in sufficient quantity. If that memory is not available for any reason, PERUSE prints an error message and returns to DOS. If you enter the PERUSE command without any parameters or with an invalid parameter, PERUSE prints a help message and returns to DOS.

PERUSE can be removed from memory as long as no other TSRs have been loaded after it. To remove PERUSE from memory, enter the command

```
PERUSE /U
```

If PERUSE cannot remove itself from memory, it displays an error message and returns to DOS.

REVIEWING THE SCROLLED DATA Once PERUSE has been loaded into memory, it captures data that rolls off the top of the screen and saves the data in a buffer in either extended or expanded memory. There are some restrictions on when PERUSE can capture video information. We will cover these restrictions later in the article, but the primary restriction is that your video adapter must be in an 80-column text mode. The number of rows, however, is not restricted to the standard 25 lines: 43- and 50-line modes are also supported.

To review data that has left the screen, press the ScrollLock key. When PERUSE detects that this key has been pressed, it shifts into redisplay mode; you see the same contents on the screen, but pressing

Top 10 Utilities

Rank	Utility
1	MONITOR - Monitors system resources
2	CHANGER - Changes look of desktop
3	WTIME - Keeps PC clock accurate
4	INCTRL - Controls Windows' Installation
5	BAT2EXEC - Compiles batch files
6	DRVLOAD - Installs device drivers
7	PCTODAY - Lists files with current date
8	BUGS - Windows 3.1 screen saver
9	FINDIRQ - Locates available IRQs
10	PRN2FILE - Captures printer output

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them"

a direction key, such as Up Arrow, will let you review scrolled information. To exit redisplay mode and return to the environment you were in before, simply press ScrollLock again.

When in redisplay mode, PERUSE recognizes the following keys: the Up Arrow and Down Arrow keys, the PgUp and PgDn keys, the Home and End keys, and the F1 key. They'll work on the numeric keypad whether NumLock is on or off. The Up Arrow and Down Arrow keys move through the scroll buffer one line at a time. The Up Arrow moves back through the saved information, and the Down Arrow moves you forward again. Similarly, PgUp or PgDn will move you backward or forward through the saved information one screen at a time. Holding any of these keys will cause the captured information to move by smoothly.

If you wish to move to either the beginning or the end of the buffer, the Home or End key (respectively) will do so. Pressing Home causes the oldest information in the buffer to be displayed. Pressing End redisplay the most recent information in the buffer, returning the screen to the same display found immediately after you pressed ScrollLock.

Lastly, there is the F1 key. Pressing F1 while in redisplay mode brings up a Help screen with a short list showing the keys you can use.

HOW PERUSE WORKS PERUSE comprises three main parts: installation, capture of screen information, and redisplay of scrolled information. When you load PERUSE, the installation portion of the program verifies that the command line is typed correctly and that adequate memory is available for the buffer requested. If no problems are found, PERUSE is installed in memory.

When you use the /U parameter to request that PERUSE be removed from memory, the installation portion of PERUSE first checks that the program is in fact memory-resident and that PERUSE was the most recently installed TSR. If everything checks out, the resident copy of PERUSE is shut down and its allocated memory, including the buffer in expanded or extended memory, is freed.

All TSRs contain some code that is used only during initialization. Typically the memory for this code is released after

the TSR is installed. PERUSE uses a variation on this theme, reusing part of the initialization area for other purposes and releasing only what isn't needed.

When PERUSE first loads, it allocates three areas in conventional memory. The first holds the resident code and data, the second holds the initialization routines, and the third stores the EMS and XMS memory handlers. After initialization is complete, the initialization code is no longer needed, but a different memory area is needed: a 1K work buffer for temporary storage of screen data. So after initialization, PERUSE overlays the memo-

.....
***PERUSE takes control of
the video BIOS interrupt
and monitors each call for
an INT 10h request.***
.....

ry allocated for initialization with the 1K work buffer and then moves the chosen memory driver (EMS or XMS) down, so it directly follows the work buffer. After this is done, whatever memory is not needed is released.

CAPTURING SCROLLED INFORMATION The second major section of PERUSE, the video interrupt handler, captures information as it scrolls off the screen. More precisely, PERUSE captures the information before it scrolls off the screen, because once it has left the screen, the information is no longer available. After the screen information is captured, it is compressed and then stored in the scroll buffer in EMS or XMS memory.

There are two ways a program can cause the screen to scroll up. One way is to call the video BIOS service routine INT 10h, Function 6. This handles both full-screen scrolling and scrolling within a defined window, but PERUSE takes action only when it detects full-screen scrolling. PERUSE cannot be used within a DOS box in Windows unless the DOS box is full screen.

Another restriction when running in a DOS session under Windows is that you must use XMS memory for the scroll buffer; EMS memory is not supported.

This is not a problem, though, since you must have an extended memory driver loaded to be running Windows in the first place.

The other way a program can cause the screen to scroll away is by calling the Write TTY function, thus causing an implicit scroll. The program writes a line-feed when the cursor is on the last line of the screen or writes any character when the cursor is at the bottom-right corner, and in this way, the program forces the screen to scroll up. PERUSE monitors scrolling from both of these methods.

When PERUSE starts, it takes control of the video BIOS interrupt and monitors each call for an INT 10h request. When an explicit scroll request is made, PERUSE checks whether the entire top line is scrolling off the screen (instead of just a window within the screen). If so, the information on that line is captured and placed in PERUSE's memory buffer, and then the request is passed to the original video BIOS handler.

Similarly, when a program requests the output of a line-feed by using a Write TTY call, PERUSE checks if the cursor is on the last line of the screen. If so, PERUSE saves the topmost line of the screen before passing the Write TTY request to video BIOS.

In some versions of video BIOS (notably, the BIOS used in the original IBM PC-XT), the Write TTY function scrolls the screen by invoking the same BIOS scroll function that PERUSE is already monitoring. Since not all versions of video BIOS uses this technique, however, PERUSE specifically checks for a Write TTY function that sends a line-feed when the cursor is on the last line or a Write TTY function that sends a character that advances the cursor from the last position of the last line. (Write TTY does not advance the cursor when a bell, backspace, or carriage return are output.)

Since PERUSE saves lines that are scrolled because of Write TTY calls, it ignores any calls to the BIOS scroll function that are invoked by Write TTY and simply passes the request along to the BIOS. Figure 1 shows how PERUSE monitors screen scrolling.

You may be wondering what PERUSE does if a program scrolls information off of the screen without calling the

The Int10 Routine

```

; *****
;
; Int10 - Interrupt 10 processor
;
; This routine intercepts the BIOS display interrupt 10h and checks for
; a scroll request (function 06) or a Write TTY request (function 0Eh).
; If either of these requests causes data to be scrolled off the screen,
; the line or lines are placed in the scroll buffer. Control is then
; passed to the BIOS. Proper checks are made to prevent reentry or
; saving of scrolled lines when the TSR is active.
;
; *****

Int10      proc     far                                ; check for scroll requests

        cmp     cs:TarActive, 0                      ; q. TSR active now?
        jne     Int10Jmp                            ; a. yes ... don't check

        cmp     cs:Int10Flg, 0                      ; q. Int 10 already in use?
        jne     Int10Jmp                            ; a. yes ... go to old one.

        cmp     ah, 06h                             ; q. scroll up request?
        je      Int10ChkS                            ; a. yes ... check it

        cmp     ah, 0Eh                             ; q. TTY Write line feed?
        je      Int10ChkW                            ; a. yes ... check it

        cmp     ax, 0B0Bfh                          ; q. scroll loaded query?
        jne     Int10Jmp                            ; a. no ... jump to next handler

        push    cs                                  ; push our segment
        pop     dx                                  ; dx = our segment
        mov     ax, 0F80Bh                          ; ax = our signature

        iret                                         ; return to caller

;
; Check Write TTY function parameters
;

Int10ChkW: cmp     al, 0dh                          ; q. writing a carriage return?
        je      Int10Jmp                            ; a. yes ... it won't scroll.

        cmp     al, 08h                             ; q. writing a backspace?
        je      Int10Jmp                            ; a. yes ... it won't scroll.

        cmp     al, 07h                             ; q. writing a bell?
        je      Int10Jmp                            ; a. yes ... it won't scroll.

        push    bx                                  ; save registers
        push    es

        mov     bx, 40h                             ; bx = segment of BIOS area
        mov     es, bx                             ; es -> video area

        mov     bx, es:VideoPos                    ; bl,bh = cursor line & column

```

```

        cmp     bl, cs:LastLine      ; q. cursor on last line?
        jne     Int10ChkW9           ; a. no ... it won't scroll

        cmp     al, 0ah              ; q. writing a line feed?
        jne     Int10ChkW8           ; a. yes ... save top line

        cmp     bh, 80-1              ; q. cursor on last char?
        jne     Int10ChkW9           ; a. no ... it won't scroll

Int10ChkW8: pop     es                ; restore registers
           pop     bx
           jmp     Int10Jmp          ; ... jump to original bios

Int10ChkW9: pop     es                ; restore registers
           pop     bx

           mov     cs:LineCnt, 1      ; save one line
           jmp     Int10Call          ; ... save and call BIOS

;
; Check scroll request parameters
;

Int10ChkS: cmp     cx, 0              ; q. top line being scrolled?
           jne     Int10Jmp          ; a. no ... skip this scroll

           cmp     dl, 80-1           ; q. whole line (80 chars?)
           jne     Int10Jmp          ; a. no ... skip this scroll

           mov     cs:LineCnt, al      ; set number of lines to save

;
; Save requested lines and call BIOS
;

Int10Call: call     VidModeOk         ; q. Video mode & page ok?
           jc       Int10Jmp          ; a. no ... don't do it

           call     SaveLines          ; save requested lines

           pushf                     ; push flags
           inc      cs:Int10Flg        ; ... Increment the call flag
           call     cs:OldInt10        ; ... call the old int 10
           dec      cs:Int10Flg        ; ... release int 10
           iredt                     ; ... return to caller

;
; Jump to original BIOS
;

Int10Jmp: jmp     cs:OldInt10         ; go directly to original Int10

Int10     endp

```



Figure 1: PERUSE monitors calls to the video BIOS to find out when a line is about to scroll off the top of the screen.

video BIOS. This is possible if a program assumes direct control of the video hardware without requesting BIOS services. If a program writes directly the hardware, PERUSE will not be not informed when data scrolls off the screen, and the data will be lost.

For speed reasons, many programs do bypass the BIOS and write directly to video hardware, but it's unlikely you'll want to use PERUSE within these programs. For example, you wouldn't have a need for PERUSE while working in your word processor, since it has its own scroll facility. PERUSE is good at capturing the output of low-level DOS utilities, such as DIR, CHKDSK, and MEM, and these are exactly the types of commands where you'd need PERUSE.

¹ Another limitation of PERUSE is

that it only captures information when the screen is in 80-column text mode. Scrolling that occurs while the video adapter is in an unsupported mode (that is, other than 80-column mode) will not be detected.

DISPLAYING THE PERUSE BUFFER

When you enter redisplay mode by pressing ScrollLock, the first thing PERUSE does is check to ensure that the video is in a supported mode. If not, PERUSE beeps, and the scroll buffer is not displayed. If it is in a supported mode, PERUSE saves the current screen contents to the scroll buffer, redisplayes the last screenful, and waits for a valid keystroke. If one of the recognized keys is pressed, PERUSE retrieves information from the scroll buffer based on which key was pressed.

The scroll buffer is stored in a memory area above the 640K conventional-memory boundary. Because of the limits of DOS and the PC architecture, special measures must be taken to access memory above 640K. One method is the Expanded Memory Specification (EMS), a standard worked out by Lotus, Intel, and Microsoft. A more recent specification for accessing this memory is the Extended Memory Specification (XMS). XMS is the method used by Windows to access memory above 640K.

EMS and XMS memory work very differently, but PERUSE contains its own internal interface to the memory drivers so that it can handle memory management with the same function calls, regardless of whether the scroll buffer is using EMS or XMS memory. Figure 2 shows

the EMS interface routine.

One difference between EMS and XMS is that XMS requires a buffer in conventional memory. Memory beyond 1 megabyte is accessed by moving data between conventional and extended memory. To store information, you first write it to conventional memory and then move it to extended memory. Similarly, to retrieve information from extended memory, you must first move it to conventional memory. The XMS driver handles the moves using a structure you pass to it.

With EMS memory, data is written to logical *pages* (16K chunks of memory). To access a logical page, the application asks the EMS driver to map the logical page into one of the four, contiguous, physical pages in upper memory. (Upper memory is the area between 640K and 1MB.) The

application may then read or modify that logical page by reading from or writing to the physical page. The logical page remains accessible until a different logical page is mapped to that physical page. EMS doesn't require a low-memory buffer, but since XMS does require it, the buffer is used for both, so the interface to memory can be the same.

PERUSE treats the EMS or XMS scroll buffer as a collection of 1K records. The most recent screen information is stored in record 0; the largest possible record number is determined by the buffer size specified on the command line when PERUSE is first loaded. When PERUSE wants to retrieve a record from the scroll buffer, it passes the record number to the memory-interface routine. The same calls are used regardless of whether the buffer is using EMS or XMS memory;

the memory interface routine determines how to access the record.

Captured and compressed screen lines are first written to the 1K work buffer in conventional memory. The number of screen lines that can be stored in 1K varies depending on the compression ratio achieved with those lines. If the compressed data will not fit in the work buffer, PERUSE writes the record to the scroll buffer and then starts building a new record.

When the scroll buffer in EMS or XMS memory becomes full, the oldest record is overwritten in a classical circular queue. The most recent information overwrites the oldest information in a never-ending circle.

For both EMS and XMS, the application must deallocate memory before exiting. If this is not done, the memory will re-

The EMS Interface Routine

[illegible]

```

;
EmsTbl    label    byte                                ; function dispatch table
dw        Ems0                                ; Initialize
dw        Ems1                                ; Read Record
dw        Ems2                                ; Write Record
dw        Ems3                                ; Get number of records
dw        Ems4                                ; Free EMS memory

;
; (Other data areas needed by driver)
;
; DDDDDDDDDDDDDDDDDDDDD-
; Interface Entry Point
; DDDDDDDDDDDDDDDDDDDDD-

Ems        proc     Far                                ; dispatch the call
            push    si                                ; save registers
            push    ds
            push    es

            cmp     ax, MaxFunction                  ; q. out of range?
            ja      EmsRtnErr                        ; a. yes ... error

            shl     ax, 1                            ; ax = ax * 2 (table index)
            mov     si, ax                          ; si = table index
            jmp     word ptr cs:EmsTbl[si]           ; go to the routine

; DDDDDDDDDDDDDDDDDDDDD
; Error return..
; DDDDDDDDDDDDDDDDDDDDD

EmsRtnErr: stc                                     ; set the carry bit

            pop     es                                ; restore
            pop     ds                                ; ... saved
            pop     si                                ; .. .. registers

            ret                                       ; return with error

; DDDDDDDDDDDDDDDDDDDDD-
; Return OK..
; DDDDDDDDDDDDDDDDDDDDD-

EmsRtnOk:  clc                                     ; reset carry bit

            pop     es                                ; restore
            pop     ds                                ; ... saved
            pop     si                                ; .. .. registers

            ret                                       ; return OK

```



Figure 2: Though EMS and XMS memory work very differently, PERUSE uses a standard interface for both. The interface routines handle the details of memory access.

The CmpData Routine



Figure 3: PERUSE uses a Run Length Encoding (RLE) compression scheme to pack screen text before storing it. This lets PERUSE store more screen lines in its buffer.

main allocated and unavailable to other applications. This is in contrast to allocated conventional memory, which is automatically freed when a program terminates. PERUSE deallocates any used EMS or XMS memory when PERUSE is removed from memory.

DATA COMPRESSION PERUSE compresses the screen information before storing it in order to increase the total number of lines that can be saved. The compression technique used is called Run Length Encoding, or RLE. The basic idea behind RLE is to replace repeating patterns in a stream of data with the number of repeats and the pattern to be repeated.

In PERUSE's implementation of RLE, the pattern's unit is a byte. Repeating strings of 3 or more bytes are compressed into 2 bytes. The first byte is the count; the second byte is the repeated character. For example, the string

"AAAA" would be compressed to the number 4 followed by the character "A". PERUSE's version of RLE is designed to accommodate video-buffer data that's 80 bytes long. Figure 3 contains the code PERUSE uses to perform RLE compression.

Since RLE compression is applied only to runs of three characters or more, the program needs a way to signal whether RLE is in use. Otherwise, the program could not tell, for example, whether the number 65 followed by "X" means 65 X's or is just the unrepeated letters A and X (65 is the ANSI code for the character "A").

This problem is solved by using the high-order bit of the COUNT variable as a sentinel. If the sentinel bit is set, the byte that follows is to be repeated the number of times indicated by the COUNT variable (after masking out the high-order bit). If the sentinel bit is not

set, it means the COUNT variable contains the number of *unrepeating* bytes that follow.

Information is stored in the video buffer as a series of alternating bytes. The first byte is the displayed character, and the second byte is the color attribute. Because of the nature of the information, the character byte is seldom identical to the attribute byte. RLE is only effective in compressing data with long repeating patterns, so this is a potential problem. PE-RUSE solves the problem by making two passes and compressing the character portion of the video information separately from the attribute portion.

In the best circumstance (that is, where all the characters and attributes have the same bit pattern), the RLE algorithm compresses the 160 bytes into 4 bytes—a 97.5 percent compression rate. In the most common case (where all attributes are the same but all or most of the charac-

ters are different), the RLE algorithm will compress those 160 bytes into 83 bytes—still very good. In the worst case (where there are no repeating strings of characters or attributes), the algorithm will actually add 2 bytes to the length of the line, so that 160 bytes becomes 162 bytes, but this situation is very unlikely to occur. All compression algorithms will increase the size of the data in some cases.

In a fairly small package, PERUSE provides several interesting techniques for programmers and important functionality for users. When you look under the hood, PERUSE demonstrates how to use EMS and XMS and how to implement simple data compression, intercept interrupts, and monitor screen activity.

At the same time, users can now receive long-winded output on very short

screens and recall the information with a keystroke. When you're running PERUSE, those video lines may be gone, but they're not forgotten! □

BOB FLANDERS AND MICHAEL HOLMES ARE PRESIDENT AND VICE PRESIDENT OF NCI SYSTEMS AND COAUTHORS OF THE BOOKS *PC MAGAZINE C LAB NOTES* AND *C++ COMMUNICATIONS UTILITIES*.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

PERUSE

PURPOSE: PERUSE is a TSR that captures and saves screen information as it scrolls off the top of the screen. Once loaded, pressing the ScrollLock key will put you in redisplay mode. You can then use the cursor keys to browse through scrolled screen data.

SYNTAX: The syntax for loading PERUSE into memory is

```
PERUSE /Xn I /En
```

where *n* is the size of the scroll buffer in kilobytes, which must be in the range 16 through 8,192.

The /X parameter tells PERUSE to create the scroll buffer in extended memory; the /E parameter tells PERUSE to create the buffer in expanded memory. An extended or expanded memory driver must be loaded in order to use PERUSE.

To remove PERUSE from memory, type

```
PERUSE /U
```

If any memory-resident programs have been loaded after PERUSE, the program will be unable to unload and will display an error message.

REMARKS: PERUSE is similar to a utility published in *PC Magazine* back in 1985: WaitaSec. But because of its age, WaitaSec works with only EGA video adapters. PERUSE works with VGA as well and stores the screen buffer in extended or expanded memory to minimize conventional-memory usage.

Like WaitaSec, PERUSE uses the ScrollLock key to turn redisplay mode on and off. When in redisplay mode, you can use the following keys to move through the scroll buffer and view scrolled information: Up Arrow and Down Arrow, PgUp, PgDn, Home, and End. Pressing the F1 key while in redisplay mode will bring up a help screen listing the cursor keys you can use.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

Hardware

SILENCING THE SPEAKER

❓ Is there a way to disable the speaker on a 386-based machine? I share a study with my husband, and the beeps and other sounds drive him crazy. Not all programs let you turn off their sounds, and while I'd like to be able to turn the sound off and on when I want, I'd settle for permanently turning it off if necessary.

*Jeri Roth
Silver Spring, Maryland*

► **PC MAGAZINE:** It's easy to disable your PC's speaker, and adding a control is not much more difficult. The hardest part is steeling yourself to open the case of your computer. Many people are loath to look inside the computer for fear of damaging something, but the innards of a PC are not all that complicated or fragile. So take a deep breath, take out the retaining screws for the case, and open the machine.

Inside, you'll find a pair of wires (often twisted together) that lead from the speaker to your computer's motherboard. One end of this pair will almost certainly terminate in a rectangular plastic block that is plugged into the motherboard. Simply lifting this block off the pins on the motherboard will disconnect the speaker and your PC will be silenced. (In a very full PC, you may have to pull out one or more interface cards to see and get at the speaker wiring.)

With just a bit more effort, however, you can modify your system so you can turn the speaker on and off at will. Just get a simple toggle switch at your local Radio Shack or other electronics store; if you get one with wire leads already attached, your job will be that much easier. You can either make a hole in your com-

puter case in which to mount the switch or simply thread the wires through a convenient ventilation slot in the case's front panel. Then instead of disconnecting the speaker wires from the motherboard, just cut *one* of the two wires. Remove about 1/4 inch of the insulation from the cut ends with a wire stripper or a knife. Twist each end of the cut wires to the wires leading to the switch, and wrap the two connections with electrical tape to insulate them. The switch will now let you turn back on the beeps and chirps when your study mate isn't in the room.

Depending on the physical layout of your system, you may need to use a longer pair of wires to connect the cut ends of the original speaker wire and the switch. Just get a small spool of solid hook-up wire at an electronics store and twist together two lengths that will run between the original cut ends and the point where you want to put your switch. Remove 1/4 inch of insulation from the four ends of this "extension cord" and attach the wires at one end to the cut speaker wire and connect the other ends to the switch. In this case, you might prefer a toggle switch that has screw terminals instead of short attached wires.

Keep in mind that this modification may void your system warranty, even

though it's about as benign an alteration as you can make. If you have any qualms, check with your system manufacturer first.—*Alfred Poor*

ADDING A PRINTER PORT

✓ **TIP** My husband and I added a laser printer to our computer system but kept our dot matrix printer for continuous form and label printing. Our computer has only one parallel port, so we decided to buy an inexpensive A/B switch box. The laser printer wouldn't work with the box, and we found out later that damage from mechanical A/B switch boxes is not covered by many laser printer warranties. An electronic switching device can cost hundreds of dollars.

We found a solution for less than \$30: We added a second parallel port. Now we can hook up the dot matrix to one parallel port and the laser printer to the other, and we don't have to hassle with switch boxes or tangled cables.

*Polly Laubach-Eckrote
Necopeck, Pennsylvania*

► **PC MAGAZINE:** A second parallel port is indeed a useful solution, especially since you can find parallel-port cards for less than \$10 in some places.

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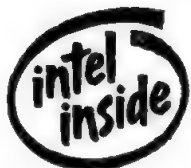
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You should note, however, that there are two possible problems with this approach. First, you may have software that doesn't know how to send output to LPT2. In such a case, a port-swapping utility such as SWAP.COM (available from the Utilities/Tips Forum of PC MagNet) will solve the problem.

More serious is the problem of interrupt conflicts. LPT2 is typically assigned IRQ5, an interrupt that may be in use by other devices, including sound cards. If you have a slot available for a second parallel port, check carefully first to make sure that IRQ5 is also available. You can do this by using the *PC Magazine* utility FINDIRQ, which can also be downloaded from PC MagNet.—*Alfred Poor*

Operating Environments

UNDERSTANDING CHKDSK

❓ I'm confused about using CHKDSK. When I run it with the /F switch, lost clusters are converted to files. If I browse the converted files, some appear to be data files and others are programs. Is there any

value to these converted files other than to clean up your hard disk?

Sometimes I find that the converted files are valid data or program files. When I run the program or load the data file, everything seems to be fine. As a general rule, when you run CHKDSK, *should* you convert lost clusters to files? What should you do with the files that are thus created?

*M. Dale Mutz
Baltimore, Maryland*

► **PC MAGAZINE:** Every disk uses a structure called a FAT (file allocation table) to keep track of which clusters of disk

space belong to what file. A file's directory entry contains the number of the first cluster, and the FAT entry corresponding to each cluster contains the number of the next cluster in the same file. The last cluster in a file has a special end-of-file marker in its FAT entry, and unused clusters are marked with 0. If your system has a program crash or a power outage during the process of saving a file, however, this chain of clusters can get disconnected from the file's directory entry. The file data is still on disk, but it's inaccessible. And these lost clusters waste space on your disk.

CHKDSK examines a disk's file system and may spot dozens of possible problems, but lost clusters are by far the most common. You should always start by running CHKDSK *without* the /F parameter. If lost clusters are reported, run it again with the /F switch. CHKDSK will ask you whether to convert the lost chains to files. If you're sure that none of your files is damaged or missing, answer no. CHKDSK will simply update the FAT, marking the lost clusters as unused, and they will soon be overwritten. But if you think there's a chance you might have lost some files, answer yes. CHKDSK will convert each chain of lost clusters into a file in the root directory, with a name like FILE0000.CHK. Scan these files right away. Save any that you can recognize as complete and valid files, and delete the rest.

The second most common problem uncovered by CHKDSK is cross-linked files. Cross-linking occurs when two different FAT entries point to the *same* next cluster. That means two different files are using the same chain of clusters after that point.

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Sometimes one of the files can be salvaged, but CHKDSK /F has a fifty-fifty chance of wrecking that file. That's why you always run CHKDSK without the /F switch first.

When CHKDSK reports cross-linked files, simply COPY both files to another disk and delete them from their original location. Run CHKDSK again to be sure there are no more problems. Now examine the two files. If you're lucky, one will be intact. The other will be fine up to a point, but the remainder will be overwritten by part of the first file.—Neil J. Rubenking

add the document's path and filename at the end of each document. Figure 1 shows a WinWord macro that automates the process.

The macro begins with a Dim statement that creates a copy of the Document Statistics dialog box. It then gets the current values for the fields in the dialog box, inserts those for the path and filename into the document, highlights the inserted text and formats it in lower-case, 8-point Times New Roman, and then ends by moving one character to the right to collapse the selection.

To use the macro, first save your document to disk so that you can give it a name. Then just move the cursor to the position where you want place the tracking information, run the macro, and re-save the file.

Bill King
Tahoe, California

DOCTRAK1

Complete Listing

```
Sub DOCTRAK1
    Dim DialogBox As DocumentStatistics
    DialogBox = Application.DocumentStatistics
    InsertText DialogBox.Directory + "\" + DialogBox.FileName
    FormatText "lower-case, 8-point Times New Roman"
    MoveRight 1
End Sub
```



Figure 1: This macro for WinWord 2.x or 6.0 will enter the directory and filename of the current file in the document you're editing.

►PC MAGAZINE: I've mentioned in previous Solutions columns that WinWord lets you print a summary-information page at the end of each document. Just choose Tools|Options, make sure there's a check in the Summary Info check box, and then Print. WinWord's summary-information sheet includes not only the file and directory, but the title, author, revision, and more. This may be more information than you need, however, and appending an extra sheet of paper to each document can be cumbersome—especially if most of your documents are

Word Processing

TRACKING WINWORD DOCUMENTS

TIP As the number of word processing files stored on hard disk grows, keeping track of them all becomes a chore. The solution we came up with in our office is to

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DOCTRAK2

Complete Listing

```

Sub MAIN
  InsertField .Field = "UserInitials \*Lower"
  Insert " "
  InsertField .Field = "filename \*Lower \p"
  StartOfLine 1
  FontSize 8
  CharRight 1
End Sub

```



Figure 2: This macro offers a more elegant way to get the same results as the macro in Figure 1 but takes advantage of features newly added to WinWord 6.0.

one-page letters.

If the drive, directory, and filename will suffice for your tracking purposes, then Mr. King's macro is just what you need under WinWord 2.x and 6.0. There are, however, a few changes you may want to make. If you're using WinWord, Version 2.x, for example, you'll probably want to add the line

```
ToggleFieldDisplay
```

after the ChangeCase command. Otherwise, WinWord 2.x will show the field code rather than the field result.

You might also want to add the user's initials to your tracking information. If so, enter the line

```
InsertField .Field="UserInitials"
```

before the Insert command shown in Figure 1. This will insert the UserInitials field from WinWord's stored User Info. To separate the initials from the drive letter, you'll also want to add a space to the beginning of the Insert line so that it starts

```
Insert " " +dlg .Directory...
```

You should be aware that WinWord, Version 6.0, offers an easier way to enter your tracking information. WinWord 6.0 users will generally be better off using the Filename field to insert the drive, directory, and filename. Figure 2 shows a WinWord 6.0 macro that will insert the UserInitials field, then a space, and then the Filename field. Both fields use the *Lower switch to specify lowercase. The \p switch, newly added for the Filename field in WinWord 6.0, tells WinWord to add the drive and directory.

The macro in Figure 2 also replaces the Font command with the Fontsize command, which lets you specify a size without needing to specify a font. (You can use this command in the WinWord 2.x version of the macro as well.) Most important, note that by using fields, you can easily update all your tracking information at any time by updating the fields. To set WinWord to

update fields automatically when printing, make sure the Update Fields check box is checked, choose Tools|Options, and then Print.

You can download these macros from PC MagNet's Utilities/Tips Forum archived as DOCTRA.ZIP.

—M. David Stone

Spreadsheets

MAGNIFYING DIFFERENCES

I use Lotus 1-2-3, Release 2.3, and recently I had to make a bar graph showing the following three values:

```

SALESMAN1 22.75
SALESMAN2 22.43
SALESMAN3 22.10

```

My boss was not happy with the results. With the y-axis beginning at 0, all three bars were almost exactly the same height, so the graph did nothing to show the differences among the three values. But when I tried setting the lowest y-axis value to 22 using 1-2-3's manual scaling options, the program ignored my request.

Finally, I decided to change the values as follows:

```

SALESMAN1 0.75
SALESMAN2 0.43
SALESMAN3 0.10

```

I then displayed the graphs with no y-axis labels, embedded the graph on my worksheet, and used the WYSIWYG facility to add mathematically bogus y-axis labels that ranged from 22.00 at the bottom to 22.80 at the top. This kludge

looked just like what I would have obtained if 1-2-3 had let me use manual scaling in the first place, but it took a lot of time. Please tell me there's a better way.

Asadullah

Faisalabad, Pakistan

► **PC MAGAZINE:** The better way is a different spreadsheet program. All the 2.x versions of 1-2-3 insist on setting the minimum y-axis value in bar graphs to 0 even if you ask for manual scaling. Later versions of 1-2-3—Release 3.4 and Release 4, for example—are friendlier. They accept nonzero y-axis minima in bar graphs. So do all versions of Quattro Pro (for DOS and for Windows) and Excel. It sounds as though this might be an auspicious moment to request an upgrade

—Craig Stinson

TWO PIES IN ONE

▼ **TIP** Suppose you want to plot two data series on a single pie graph. Your spreadsheet's documentation will tell you this can't be done, but if you're using Microsoft Excel, Version 4.0, it can.

First, enter your data normally, in two columns. Then, using values much larger than those found in the rest of your data, add a dummy row at the bottom, like so:

	1993	1994
Apples	10	13
Peaches	19	23
Pears	11	9
Plums	16	27
Oranges	14	5
Pineapples	17	16
Bananas	13	7
Dummy	50	50

Now, follow these steps:

- Select the data and press F11, then maximize the chart window.
- Choose Gallery | Combination, type 1.
- Choose Format | Main Chart and under Main Chart Type, select Pie.
- Choose Format | Overlay and under Main Chart Type, again select Pie.
- Select the slice for the dummy data (it's the largest slice) and drag it away from the pie's center.
- Go back to the worksheet and use the Edit | Clear command to erase the con-

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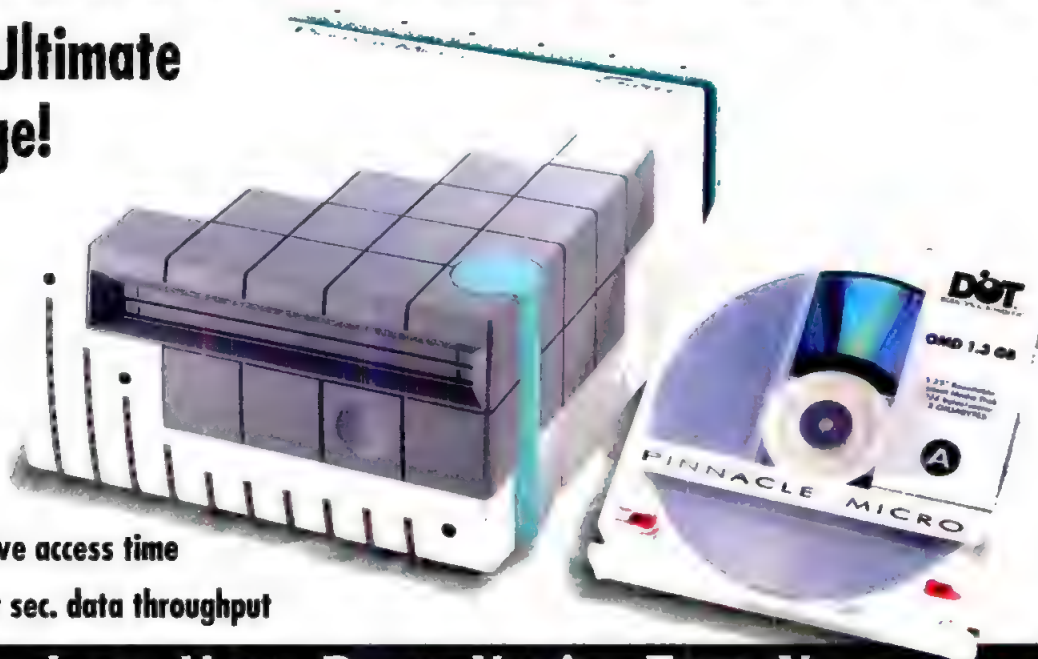
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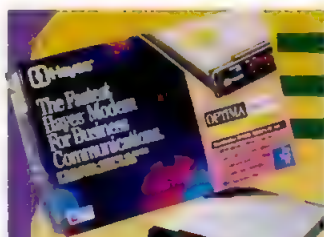
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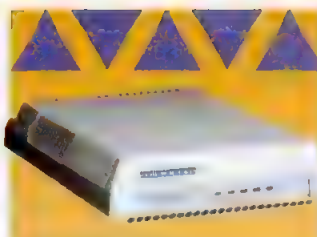
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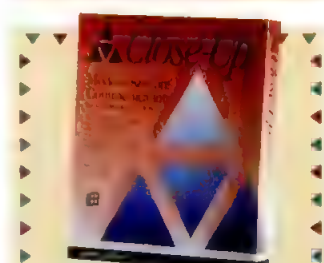
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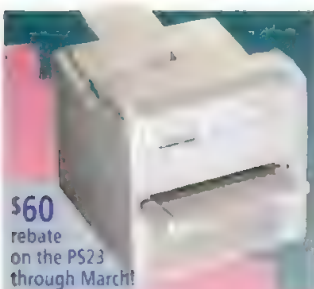
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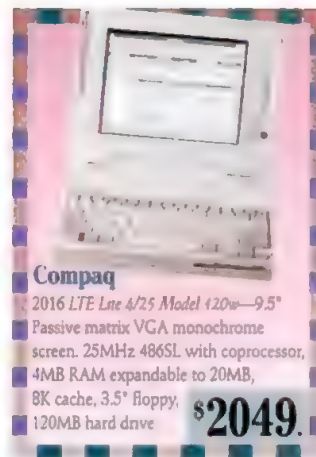
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tents of the dummy row.

- Add labels as desired.

The resulting graph will look like the image in Figure 3

Shane Devenshire
Walnut Creek, California

► **PC MAGAZINE:** When you create a combination chart in Excel 4.0, the program generates two charts and lets you format them independently. Therefore, although you won't find the combination of pie chart over pie chart in Excel's gallery of predefined types, you can create such a beast by following the steps described by Mr. Devenshire.

Normally, if you plot one pie on top of another, you'll see only one pie—the one represented by your overlay series. When you drag a slice out of the top pie, however, Excel reduces that pie's radius, which makes the outer edge of the un-

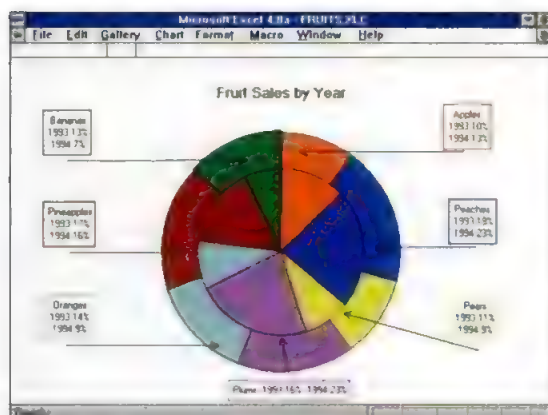


Figure 3: The multistep process needed to produce a pie-within-a-pie chart such as this in Excel 4.0 is unnecessary in Excel 5.0.

derlying pie visible. If you explode a pie slice then change its value to 0, the exploded slice disappears, but each remaining slice retains its shrunk radius.

Mr. Devenshire's clever technique will not work in Lotus 1-2-3 for Windows or in Quattro Pro for Windows. These programs allow only a fixed set of combination graphs—line over bar, line over area, and a few others—and pie over pie is not one of the available options.

If you're upgrading to Excel 5.0, you won't need this tip to plot multiple pie series. Excel 5.0 offers donut charts, which allow you to plot two or more data series as concentric rings.—*Craig Stinson*

Databases

ELIMINATING DUPLICATES IN PARADOX

✓ **TIP** If you want to eliminate the duplicates from a long list of data stored in Paradox, simply restructure the table and make the repeating field a key field. When you then press F2 to DO-IT!, the duplicates will pop out into their own table, ready for you to do with them as you wish.

Wayne Schulz
Wethersfield, Connecticut

► **PC MAGAZINE:** Mr. Schultz's tip must be used with care, or you may lose data. For safety, it's a good idea to use Tools/Copy/Table to make a copy of the original table and Tools/Copy/JustFamily to copy the table's family members before you start restructuring.

Paradox strictly enforces the rule that primary-key fields may not contain duplicate values. Thus, if you change an existing field from a nonkey field to a key field, Paradox checks that column for duplicates and removes all but the first match in any repeating group. The removed records are placed in a special, temporary table called KeyViol (key violations), which you can then examine to check whether the duplicates are real.

Note that the KeyViol table is *temporary*. Don't quit Paradox and come back expecting to find it. Before closing Paradox, rename the KeyViol table and save it. (Use the File/Utilities/Rename menu item in Paradox for Windows, or Tools/Rename in Paradox for DOS.)

You should avoid the temptation simply to delete all of the apparent duplicates that show up in the KeyViol table. Records that seem to be duplicates when you're using an automated method such as this often turn out not to be. One possibility is that an erroneous value may be entered that duplicates an existing value. In such a case, correcting the entry will eliminate the duplication if you haven't

mechanically thrown out the record.

Moreover, sometimes an apparent duplicate is legitimate. For instance, two records that contain a last name of "Jones" might not represent the same person. In fact, two records that have name fields containing "Tom Jones" and that have the same address, city, state, and ZIP code *still* might not designate the same individual. The point to remember is that both the first record in a repeating set (the one that remains in your original table) and the ones that end up in KeyViol need to be examined closely by someone who looks at all the fields and is qualified to determine whether the records are genuinely duplicates.

Once you change the repeating column or columns to a key field and produce a KeyViol table, you must remember to restructure the original table again to restore the original key fields. (Remember that key fields must appear first in the field list.)

After you've restored the key fields in the original table and removed any records from KeyViol that prove to be real duplicates, you can reintegrate the remaining records back into the original table. To do this, first rename the KeyViol table—perhaps to AddBack. In Paradox for DOS, you then use the Tools/More/Add menu item to put the AddBack records back to the original table. In Paradox for Windows, you'd use File/Utilities/Add. Only then is it safe to delete both the AddBack table and the backup copy of the original table.

—*Sal Ricciardi*

Graphics

SERVICE BUREAUS AND TRUETYPE FONTS

❓ I'm about to embark on a book-length, self-publishing project and have decided to produce it electronically, thus eliminating the need for camera-ready art. I intend to use a desktop publishing program, such as Aldus PageMaker, Version 5.0, but I'd like to avoid purchasing and converting to PostScript fonts in place of the TrueType fonts I use with Microsoft Word for Windows. In the September 14, 1993, issue of *PC*

Magazine, you detailed problems using TrueType fonts with Aldus FreeHand, and I'm concerned that these fonts may create trouble when I send the output file to a service bureau.

Thomas Wildenberg
New City, New York

► **PC MAGAZINE:** Aldus FreeHand's inability to print TrueType fonts to a PostScript printer is quite simply a fluke. FreeHand's anomalous performance with TrueType fonts has absolutely no bearing on PageMaker's capabilities.

That said, however, sending documents containing TrueType fonts to a service bureau does present a few potential pitfalls. These latent problems have nothing to do with PageMaker per se. Rather, they reflect the fact that most service bureaus have built up large libraries of PostScript—also known as Adobe Type 1—fonts. Although the situation is changing, it's still relatively rare to find a service bureau that offers a wide selection of TrueType fonts. Indeed, most service bureaus still use Macs—not PCs—to drive their high-resolution typesetting machines.

The most common problem caused by this particular situation is font substi-

any missing fonts.

Luckily, the latest release (Version 5.0) of PageMaker provides several powerful features that help you print TrueType fonts at a service bureau. Taking a few moments now to familiarize yourself with these options can save you from time-consuming and expensive mistakes later on.

While it may seem like putting the cart before the horse, the *first* thing you must do is to choose your final output device. You do this not in the Print dialog box but in the Page Setup dialog box under the Compose to Printer section. The only tricky part is that you must choose the service bureau's high-resolution printer—not your local, desktop laser printer—at this point. PageMaker uses the

information in this dialog box to determine which fonts will be resident in the printer and which fonts must be downloaded at print time. When you choose a high-resolution PostScript device, PageMaker knows that it must download all TrueType fonts at print time. Note that you should ask your service bureau for an up-to-date copy of the correct printer driver, together with its associated PostScript Printer Description (PPD) file. You then use the Windows Print Control Panel to install the service bureau's printer on your system.

Choosing a high-resolution printer in the Page Setup dialog box does not keep you from proofing your document on your local laser printer. PageMaker contains a separate Print dialog box that allows you to output your document to any Windows-compatible printer, including non-PostScript printers such as your own. Even though PageMaker will print to your local output device, however, it

composes the text for the printer specified in the Page Setup dialog box. This method ultimately produces a more accurate proof in terms of both font availability and line breaks.

When you're ready to send your document to the service bureau, open the Print dialog box. Make sure that the current printer is the same printer you designated in the Page Setup dialog box.

You should also select the correct PPD file (it will appear in the Type drop-down list), which gives PageMaker access to such highly detailed information about the printer as whether it uses optimized halftone screens or nonprinting margins. Click the Options button and in the next dialog box (as shown in Figure 4), under the PostScript section, select the follow-

ing options: Write PostScript to file, Normal, and Include downloadable fonts. Once you've indicated a path, entered a filename, and clicked the Print button, PageMaker will create a disk-based file that contains your design, together with all the TrueType fonts needed to print it.

There's only one drawback to using this system. Embedding fonts in a PostScript printer file increases the size of the file dramatically—up to several hundred kilobytes for each font used. So don't be surprised when your TrueType-laden PostScript files no longer fit on a single floppy disk.

One final caveat: If you want PageMaker to download all of your TrueType fonts consistently, you must make sure that the Advanced Options in the Print Control Panel (click Setup|Options|Advanced) are configured with the default values. In other words, you must be sure that Windows is set to download TrueType fonts as Adobe Type 1 outlines and that the Substitution Table is either disabled or explicitly identifies each of your TrueType fonts as a downloadable soft font.

—Luisa Simone

.....
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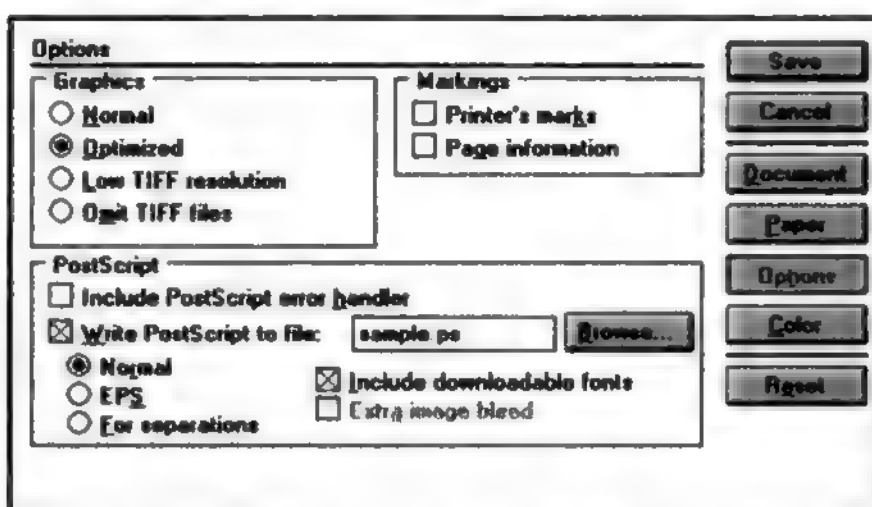


Figure 4: PageMaker's new Print module lets you save PostScript printer files to disk easily. The many important options in this dialog box control the quality of images and prep for color separation. The options that control TrueType font downloads are found under the PostScript section.

tution. When you generate your document locally, PageMaker (in conjunction with the Windows printer driver) automatically downloads the necessary TrueType fonts from your hard disk to your laser printer. If your service bureau does not have the same TrueType fonts installed, Courier will be substituted for

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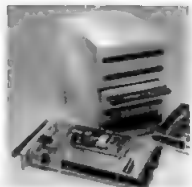
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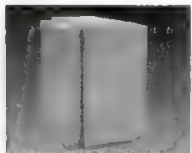
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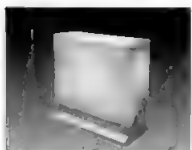
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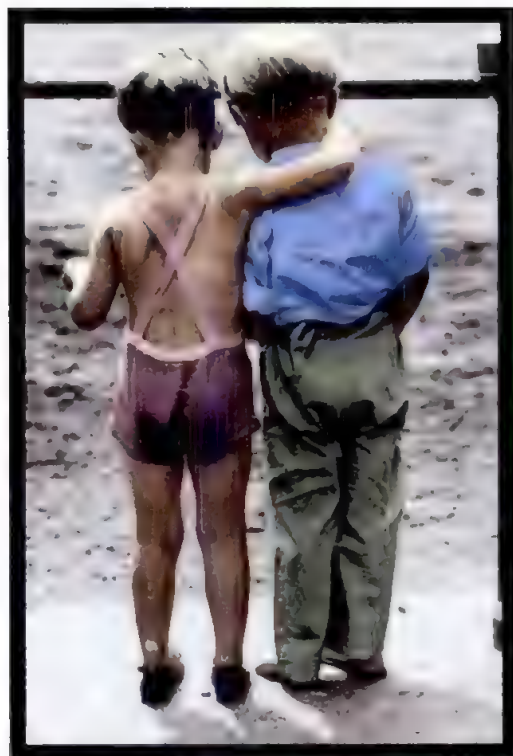
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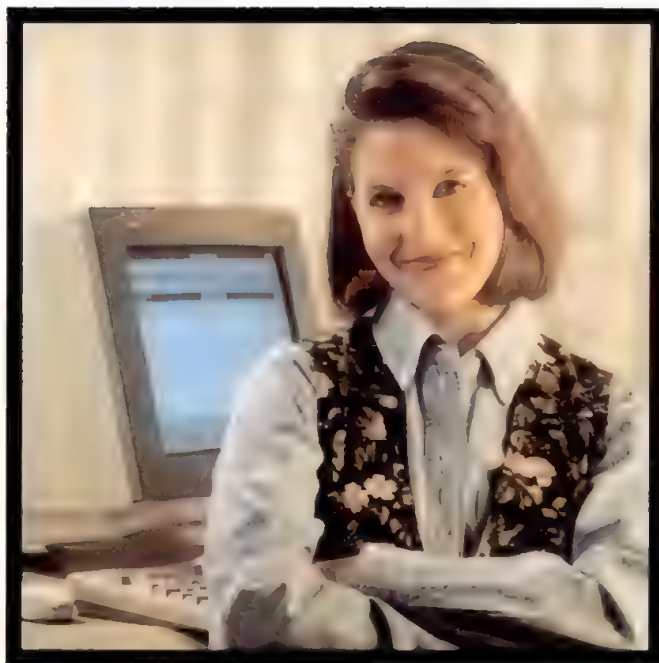
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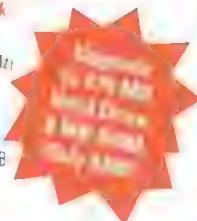


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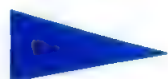
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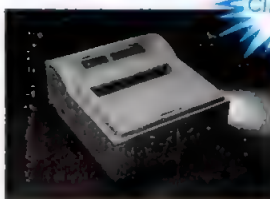
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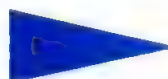
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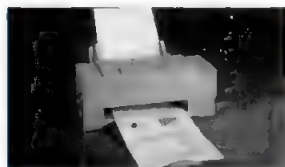
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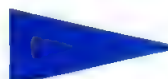
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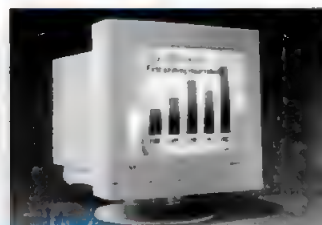
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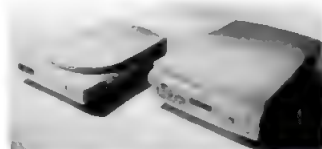
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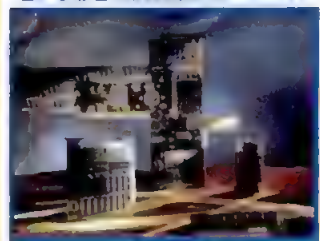
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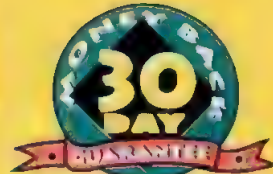
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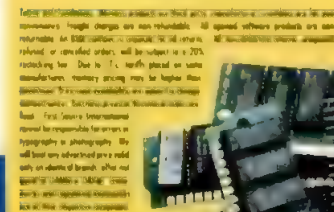
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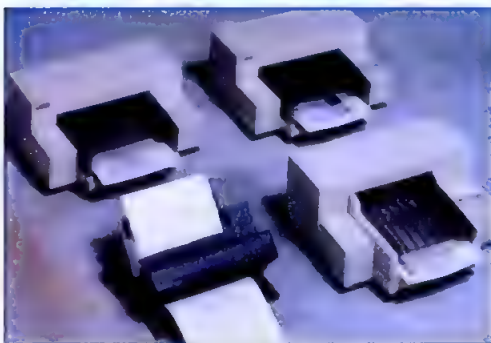
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486DX	33 MHz	212 MB/13 ms	3	2/1	512K	6.1	6381M50	Call	'1629
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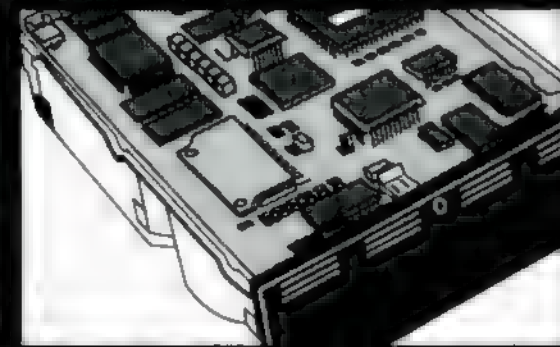


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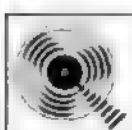
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SCSI			
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270MB	12ms	LPS270S	\$245
342MB	12ms	LPS340S	\$289
541MB	12ms	LPS540S	\$459
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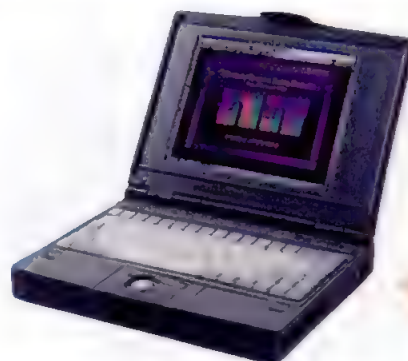
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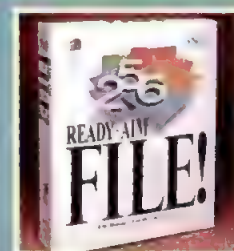
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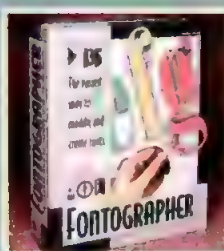
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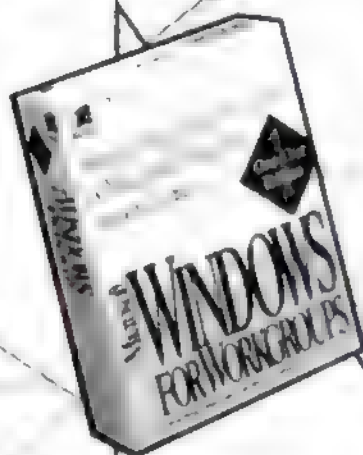
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**KENOSHA
COMPUTER CENTER**
2133 91st Street
Kenosha, Wisconsin 53143

Just Right for Small Businesses

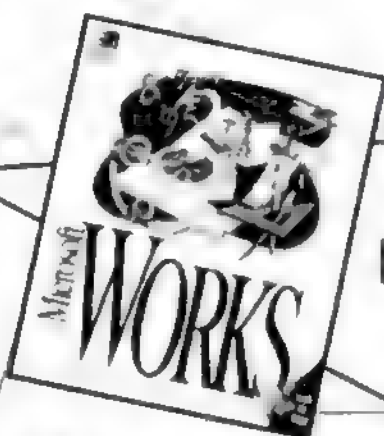
Microsoft Windows for Workgroups 3.11
"Networking Made Easy"

\$145



Microsoft Office Standard 4.0
"A Collection of Full-Featured Products
that Work Alike and Work Together"

\$269*



Microsoft Works for Windows 3.0
"Essential Tools for Easier
Everyday Computing"

\$101

Microsoft has created software
that's just right for small
businesses. Software that's easy to learn and
use. Software that provides professional
results with a minimum investment of time.
Software that simplifies and automates the
computing process while allowing users to
complete a wide variety of tasks quickly and easily.
Plus software that makes
working together in a group
easier than ever before.



Microsoft Publisher 2.0
"Easy Desktop Publishing
with Professional Results"

\$95



Microsoft Scenes
"The screen saver for
Microsoft Windows
that's out of this world."

\$24



Microsoft Profit
"Business Management
and Accounting Made Easy"

\$134

And Software Spectrum knows what's just right for small
businesses too. For over a decade, we've been providing
superior customer service and value to companies just like yours.
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CIRCLE 282 ON READER SERVICE CARD

VTech Makes Buying Direct Easy...

486DX2/66 Multi-Media Hardware Feature Comparison

Feature	VTech	DELL	Gateway	ZEOS
Memory	8MB	8MB	8MB	8MB
Hard Drive	426MB	450MB	424MB	426MB
Floppy Drives	3.5"	3.5"	3.5"	3.5"
Video	1MB VLB	1MB VLB	1MB VLB	1MB VLB
3 Year Warranty	Yes	No	No	No
Double Speed CD-ROM	Yes	Yes	Yes	Yes
Sound Card & Speakers	Yes	Yes	Optional (\$132)	Optional (\$148)
Modem	Yes	Optional (\$79)	Optional (\$49)	Optional (\$49)
Remote Diagnostics Sftw.	Yes	No	No	No
Case	Full Size	Desktop	Baby AT	Desktop
External Cache	128K	128K	128K	No
Monitor	15"	15"	15"	Upgrade (\$95)
PC Computing Service	★★	★★	★★	★★
Value Rating (Aug 1993)	★★★	★★	★★	★★
Price	\$2199	\$3074	\$2476	\$2762

In 1993 Computer Shopper singled out VTech as one of the fastest growing companies in the PC industry. The reason is simple, we are the manufacturer - not an assembler of someone else's components - which means we can truly deliver "Technology at Prices You Can Afford."

- VTech designs and manufactures our own components so we control the quality, features and performance.
- With over 11,000 employees and 3 research and engineering labs VTech has the technology and resources to build incredible systems.
- Our prices are among the lowest in the industry because we supply systems to some of the largest manufacturers in the world and that helps us keep production high and prices low.
- 3 year warranty - PC Computing gave VTech a 5 Star Service Value Rating beating out Dell, Gateway, ZEOS, IBM and Compaq.

The VTech Multi-Media systems are available with VTech's integrated local bus or with our new VESA local bus. Each system also includes Compton's Interactive Encyclopedia, Webster's Dictionary and World Atlas which will turn your computer into a complete information center for the whole family.



BEST
BUY

...Multi-Media Systems You Can See and Hear

Expo 486SX33M

- Pentium Technology Ready
- 4MB RAM
- 250MB 13ms IDE Hard Drive
- Double Speed CD-ROM
- Stereo Sound Board
- Compton's Interactive Encyclopedia, Webster's Dictionary and World Atlas
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1449

\$1399 with 486SX25

Expo 486DX33VM

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 4MB RAM with 128KB Cache
- 340MB 13ms IDE Hard Drive
- Double Speed CD-ROM
- Stereo Sound Board
- Compton's Interactive Encyclopedia, Webster's Dictionary and World Atlas
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Dual Cooling Fans
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1799

\$1899 with 486DX2/50

Expo 486DX2/50VM

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Double Speed CD-ROM
- Stereo Sound Board
- Compton's Interactive Encyclopedia, Webster's Dictionary and World Atlas
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Dual Cooling Fans
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1999

\$2199 with 486DX2/66

Expo 486DX2/66VM

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 16MB RAM with 128KB Cache
- 527MB 12ms IDE Hard Drive
- Double Speed CD-ROM
- Stereo Sound Board
- Compton's Interactive Encyclopedia, Webster's Dictionary and World Atlas
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Dual Cooling Fans
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$2599

VTECH® Technology You Can Afford™

Hot New VESA Systems...



The Expo 486 VESA System with Multi-Media upgrade

The VTech VESA systems have been specially optimized to deliver the speed and graphics performance that today's Windows applications demand. Each system is equipped with two VESA slots and extra attention has been placed on system compatibility with a wide range of VESA cards. These systems deliver great Windows performance and the extra features you want, at prices you can afford.

The ExpoTech family of VESA systems is available with a wide range of processors, hard drives and memory combinations. All VTech systems are covered by a 3 year warranty and include the extra features and support VTech is known for.

- ♦ 2 VLB Slots
- ♦ Novell Certified
- ♦ Advanced case design with dual cooling fans
- ♦ 30 day money back guarantee

The VTech VESA systems are loaded with the extra features. Dual Cooling Fans keep the processor, system board, and option cards cool. This means if you upgrade to the Pentium OverDrive Processor it will be safe and reliable. In fact, these systems have been Intel Verified: for the Pentium™ OverDrive™ Processor.



BEST
BUY

...Prices You Can't Beat

Expo 486SX33V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 4MB RAM
- 250MB 14ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Dual Cooling Fans
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1199
\$1399 with 486DX33

Expo 486DX33V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 4MB RAM with 128KB Cache
- 340MB 13ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Dual Cooling Fans
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1549
\$1599 with 486DX2/50

Expo 486DX2/50V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Dual Cooling Fans
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

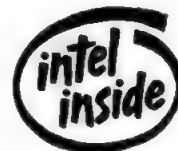
\$1749
\$1949 with 486DX2/66

Expo 486DX2/66V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 16MB RAM with 128KB Cache
- 527MB 12ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Dual Cooling Fans
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$2299

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VTech Power Systems...

VTech is the first and only company to bring Symmetrical Multiprocessing to the desktop at prices that blow away even single processor systems. Just look what the experts are saying.

- "The overall performance of the VTech gave it the highest rating of any of the 486 systems, and the jaw dropping price is outstanding."
Computer Shopper, February 1994
- "The awesome VTech Platinum beats the Pentium and costs a cool \$3,995 [Now Even Lower!]"
Computer Shopper, February 1994
- "Multiprocessing is clearly the wave of the future."
PC Week, August 23, 1993
- "VTech leads in PC Multiprocessing."
PC Magazine, October 12, 1993



The VTech Platinum SMP with CD-ROM

VTech is the first and only company to bring Symmetrical Multiprocessing to the desktop at prices that compete with single processor systems. VTech provides you with three upgrade paths. From the single processor Platinum 486 you can upgrade to dual 486 processors, a single Pentium™ Overdrive™ Processor, or for the ultimate in power and performance, dual Pentium™ Overdrive™ Processors.

Pentium systems are the next frontier of PC performance. If you have a need for speed the VTech Pentium systems will deliver. Utilizing the PCI bus the VTech systems deliver high power at breakthrough pricing.



BEST
BUY

...Double Your Power, Not Your Price

Platinum 486DX2/50

- Intel 486DX2/50 Processor
- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM
- 424MB 13ms IDE Hard Drive
- 256KB Copy Back Cache w/Cast Out Buffering
- SCSI II w/ built-in BIOS support
- 16550 Serial Port Controllers
- Multiprocessor Upgrade Slot
- S3 VLB Accelerator with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1999
\$2299 with 486DX2/66

Platinum 486DX2/66

- Intel 486DX2/66 Processor
- Intel Verified: for the Pentium™ OverDrive™ Processor
- 16MB RAM
- 424MB 13ms IDE Hard Drive
- Double Speed CD-ROM
- 256KB Copy Back Cache w/Cast Out Buffering
- SCSI II w/ built-in BIOS support
- 16550 Serial Port Controllers
- Multiprocessor Upgrade Slot
- S3 VLB Accelerator with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$2799

Platinum 486DX2/66

- Dual Intel 486DX2/66 Processors
- Intel Verified: for the Pentium™ OverDrive™ Processor
- 16MB RAM
- 527MB 12ms IDE Hard Drive
- Double Speed CD-ROM
- 256KB Copy Back Cache w/Cast Out Buffering
- SCSI II w/ built-in BIOS support
- 16550 Serial Port Controllers
- S3 VLB Accelerator with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- Windows NT
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$3799

Platinum P5-60

- Intel 60MHz Pentium™ CPU
- 8MB RAM with 256k Cache
- 424MB 13ms IDE Hard Drive
- PCI Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- Enhanced Parallel Port
- High Speed Serial Port Controllers
- 15" VTech HiRez Monitor
- Full size Metal Desktop Case
- Double Speed CD-ROM
- MS-DOS 6.2 & Windows 3.1
- Quality Keyboard, Mouse
- 3 Year Warranty
- Next generation P5T Pentium Overdrive Processor Ready
- Dual Cooling Fans
- Self Sensing setup for HD and memory

\$2799
\$3299 with 16MB and 527MB HD

VTECH® Technology You Can Afford™

VTech Value Systems...

The Expo 486 Integrated System

The ExpoTech series of integrated systems from VTech have been our most popular systems. Their great combination of performance, features, and low price have made them the clear choice for anyone looking for great value.

Integrated means we've combined as many features and performance enhancements as possible into the main system board. This integration creates a well designed board with exceptional reliability and performance.



Expo 486SX33

- Pentium Technology Ready
- 4MB RAM
- 210MB 12ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" and 5.25" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1149
\$1133 with 486SX25

Expo 486DX33

- Pentium Technology Ready
- 4MB RAM with 128KB Cache
- 340MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" and 5.25" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1499
\$1549 with 486DX2/50

Expo 486DX2/50

- Pentium Technology Ready
- 4MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" and 5.25" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1599

Expo 486DX2/66

- Pentium Technology Ready
- 8MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" and 5.25" Diskette Drive
- 15" VTech HiRez Monitor
- Full Size Metal Desktop Case
- 9600/2400 Data/Fax Modem
- Remote Diagnostics Software
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty

\$1899

...Power Portables



ExpoNote 486SLC/33

- 4MB RAM, 120MB Hard Drive
- Removable Hard Drive
- 640x480 VGA with 64 grey levels
- Simultaneous External VGA port
- 3.5 Diskette Drive
- 9600/2400 Data/Fax Modem
- MS-DOS 6.0 & Windows 3.1
- Only 2.1"(H) x 11.4"(W) x 9.25"(D)
- Power management functions
- Full Size Mouse

\$1299
\$999 with 386SX/33
Modem not included in 386SX/33

The ExpoTech Notebooks offer a great combination of features and price. The removable hard drive provides versatility usually found only on systems costing hundreds more.

- Portable - Weighs less than 7lbs.
- Powerful - 4MB RAM and 120MB HD
- 9600/2400 Data/Fax modem
- 1 Year Warranty on Notebooks

VTech Computers, Inc., 800 Church Street, Lake Zurich, Illinois 60047

7 days a week: Central Standard Time Monday-Friday 7:00am-8:30pm, Saturday 9:00am-6:00pm
Sunday 10:00am-3:00pm, Fax 1-800-947-3976, Government & Education 1-800-947-6461

Software, modem & service package for desktop & tower systems only

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CIRCLE 305 ON READER SERVICE CARD

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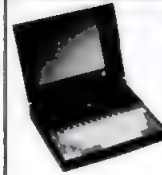
CALL FOR UPDATED PRICES

DEE ONE SYSTEMS MONTHLY SPECIALS

SUPER SALE

	MONITOR WITH CPU	BASIC SYSTEM +120MB HD +14" MONO & VGA CARD	BASIC SYSTEM +120MB HD + VGA CARD MONITOR	BASIC SYSTEM +120MB HD + VGA CARD MONITOR	BASIC SYS w/ 4MB RAM 1.2 & 1.44 FDD +120MB HD + VGA CARD MONITOR	BASIC SYS w/ 4MB RAM 1.2 & 1.44 FDD +200MB HD + VGA CARD MONITOR	BASIC SYS w/ 4MB RAM 1.2 & 1.44 FDD +340MB HD + VGA CARD MONITOR
		{200MB HD Add \$50}	{200MB HD Add \$50}	{200MB HD Add \$50}	{170MB HD Add \$20}	{200MB HD Add \$20}	{340MB HD Add \$170}
486SX-25	\$258	\$528	\$608	\$718	\$808	\$1,018	\$1,038
486SX-33	228	598	628	678	708	878	1,048
486SX-33	458	628	658	688	698	1,298	1,278
486SX-33	408	628	618	608	658	1,108	1,238
486SX-33	308	478	718	708	658	1,008	1,138
486SX-33	288	468	698	748	638	1,048	1,118
486SX-33	188	358	578	628	718	828	888
486SX-33/120MB HD	608	628	1,078	1,128	1,218	1,378	1,498
486SX-33/120MB HD	638	708	1,098	1,088	1,178	1,338	1,458
486SX-33/120MB HD	478	628	668	618	1,008	1,108	1,208
486SX-33/120MB HD	468	628	678	628	1,018	1,128	1,208
486SX-33/120MB HD	438	628	648	638	688	1,148	1,188
486SX-33/120MB HD	384	628	662	652	642	1,102	1,222
486SX-33/120MB HD	308	428	718	708	658	1,018	1,138
486SX-33/120MB HD	288	408	708	708	648	1,008	1,128
486SX-33/120MB HD	288	408	688	748	638	988	1,048
486SX-33/120MB HD	154	318	558	608	688	858	878
486SX-33/120MB HD	132	298	532	582	672	832	852
486SX-33/120MB HD	144	304	542	582	682	882	882
486SX-33/120MB HD	86	298	488	548	638	788	818
486SX-33/120MB HD	72	294	472	522	612	772	802
486SX-33/120MB HD	84	228	468	518	608	768	808

BEST PRICES IN THE WORLD



- 4MB RAM INSTALLED
- 120MB HARD DRIVE
- 1.44 FLOPPY DRIVE
- 1 SERIAL / 1 PARALLEL
- BUILT-IN TRACKBALL
- BATTERY PACK
- CARRYING CASE
- IBM PC DOS 6.1

Best Buy	VGA Mono	Dual Scan Color	Active Matrix Color
486SX-25	\$1,325	\$2,015	\$2,785
486SX-33	1,385	2,075	2,835
486DX-33	1,475	2,165	2,985
486DX-50	1,475	2,175	2,985
486DX-66	1,675	2,375	3,185

OPTIONS

- Upgrade to 8MB RAMAdd \$268
- 200MB Hard Drive.....Add \$128
- 340MB Hard Drive.....Add \$328
- Internal Battery Pak.....Add \$94
- Internal Fax Modem.....Add \$128
- Pocket Fax Modem.....Add \$118
- Docking Station.....Add \$368
- Please Call For PCMCIA Slot Model

*BASIC SYSTEM CONFIGURATION: Motherboard & CPU, 1MB memory, IDE controller, 1.44MB floppy drive, 1.44MB floppy drive, internal clock/calendar, enhanced case with power supply, and 101 key enhanced keyboard.

LOCAL BUS STOP

Pentium PC-60 / PC-66\$1,948 / 2,248
486DX2-50 / DX-50\$1,278 / 1,248
486DX2-50 / DX-33\$1,068 / 1,068
486SLC2-66 / SLC2-66\$1,038 / 998

• Local Bus Motherboard
• Local Bus VGA Card
• Local Bus Hard Drive
• Local Bus Floppy Drive
• Local Bus Mouse
• Local Bus Keyboard
• Local Bus Joystick
• Local Bus Joystick

• 4MB RAM
• 1.44MB Floppy Drive
• 1.44MB Floppy Drive
• 1.44MB Floppy Drive
• 1.44MB Floppy Drive
• 1.44MB Floppy Drive
• 1.44MB Floppy Drive
• 1.44MB Floppy Drive

• 486SX-25
• 486SX-33
• 486DX-33
• 486DX-50
• 486DX-66
• 486DX-66
• 486DX-66
• 486DX-66

NEW HARD DRIVES

120mb 15ms (IDE)	\$152
130mb 15ms / 170mb 17ms (IDE)	174 / 164
212mb 16ms / 250mb 14ms (IDE)	194 / 214
340mb 15ms / 540mb 12ms (IDE)	258 / 428
200mb 16ms (SCSI)	244
340mb 13ms (SCSI)	348
540mb 12ms (SCSI)	484
1.2GB 13ms (SCSI)	848
2.0GB 13ms (SCSI)	1,128

MATH COPROCESSORS

80287-10	\$40
387SX-33 / 25	48 / 46
387DX-40 / 33	52 / 50

PRINTERS

Citizen GSX-190 (9-Pin)	\$158
Citizen GSX-220 / 230 (24-Pin)	188 / 248
Citizen GSX-240 / 145 (24-Pin)	298 / 378
Color Option for Citizen Printer	46 / 66
Panasonic KX-P1150 / 2023	138 / 108
Panasonic KX-P2123 / 2124	238 / 316
Panasonic KX-P1624 / 2624	376 / 396

KEYBOARDS

101 Enhanced Keyboard (Mitsumi)	\$116
MaxSwitch / Keytronics	28 / 30
MaxiPro II (124 Key Programmable)	54
Focus 2001 / 7000 (w/Trackball)	36 / 48
Focus 8000 (w/Calculator) / 9000	44 / 58
Omnikay 101NI / 102 / Ultra	68 / 88 / 98

VIDEO CARDS AND MONITORS

VGA-256K / 512K	\$28 / 38
1MB SVGA Card (1024x768x256)	58
Windows Accelerators w/1MB	60
Trident / Cirrus Logic w/1MB (VLB)	74 / 74
Genoa 8500 VLB w/1MB	96
ATI Graphic Ultra w/Mouse	152
ATI Graphic Ultra Plus w/2MB	226
ATI Ultra Pro w/2MB (ISA / VLB)	314 / 314
ATI Ultra Pro w/2MB (EISA / PCI)	348 / 368
Diamond Speed Star Pro VLB / ISA	104
Diamond Stealth 24VLB w/1MB	144
Diamond Viper w/2MB (VLB / PCI)	356 / 408
Orchid Fahrenheit 1280+ w/1MB	138
Orchid Fahrenheit VLB w/1MB	140
Orchid Celsius VLB: 1MB / 2MB	200 / 204
MAG 15F (15") / 17F (17")	488 / 868
Nanao F340iw / F550iw	598 / 1,068
Nanao T560i / F560iw	1,648 / 1,348
NEC 3V / 4FG / 5FG	548 / 676 / 1,084
Sony 1430 / 1604 / 1730	548 / 928 / 958
Viewsonic 4E / 6E / 14E	284 / 284 / 344
Viewsonic 15E / 15	368 / 448
Viewsonic 17G / 17 / 20	798 / 958 / 1,538
Hitschi CM-2096 (20")	1,294
14" Mono	80
14" VGA Mono	100
14" Super VGA (1024x768, 0.39)	190
14" Super VGA (1024x768, 0.28)	218
14" Super VGA (1024x768, 0.28) II	238
15" Super VGA (1280x1024, 0.28)	330
17" Super VGA (1280x1024, 0.28)	594

CD ROM / MULTIMEDIA

Creative Sound Blaster Pro Deluxe	98
Mediavision Jazz 16	108
Mediavision Pro Audio Spectrum 16	136
Mitsumi or SONY CD-ROM w/Card	138
Mitsumi Double Speed CD-ROM w/card	176
Panasonic CD-562 Dbl Speed w/card	186
Sony Double Speed CD-ROM w/card	166
Chinon CDS535 (SCSI) Internal	318
Toshiba XM-3401B 200ms (SCSI)	338
Trantor (SCSI) Host with Driver	50
Creative Edutainment CD16 Upgrade Kit	466
Speakers System	10

HARD/FLOPPY DRIVE ADAPTERS

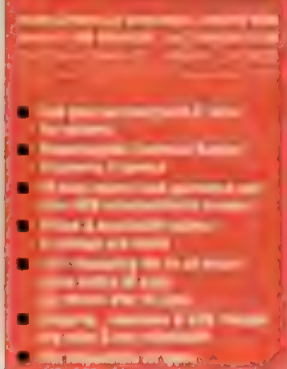
IDE 2FD/2HD Cache Controller (DK)	\$88
Vesa Local Bus IDE	28
Adaptec SCSI 1542CF / 1542CFK	178 / 235
Adaptec SCSI 2842 (EISA VLB)	278
Bustek SCSI 4455 (VLB) / 742K (EISA)	260

MISCELLANEOUS

2400 Modem	28
Fax Modem (9600 Fax, 2400 Modem)	40
Fax Modem (14,400 Fax, 14,400 Modem)	108
US Robotics 14,400 FM Int / Ext	150 / 168
3-Button Mouse	9
Logitech Mouseman Serial / Bus	50 / 62
Microsoft Mouse Serial / Bus	36 / 56
Conner Tape Backup 250MB (w/Tape)	144
Colorado Tape Backup DJ-10/20	94 / 158
Colorado Traikler JT-20 (250MB) Ext	338
16 Bit Ethernet Card Coax/10 Base T	42

Dee One Systems

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COMPAQ

ProLinea Desktops		
Processor	Hard Drive	Price*
486SX/33	120MB	\$1109
486SX/33	240MB	\$1259
486DX/33	120MB	\$1389
486DX/33	240MB	\$1469
486DX/33	340MB	\$1619

Lease for \$50/mo.

*Monitors priced separately

ProLinea Net1

\$1279

Lease for \$50/mo.



ProLinea Desktops

ProLinea MT			
Processor	RAM	Hard Drive	Price*
486SX/33	4MB	270MB	\$1399
486SX/33	4MB	340MB	\$1499
486DX2/66	8MB	525MB	\$2469

Lease for \$51/mo.

DeskPro/M

Processor	RAM	Hard Drive	Price*
486DX/33	8MB	240MB	\$2659
486DX/33	8MB	340MB	\$3069
486DX2/66	8MB	510MB	\$3739

Lease for \$98/mo.

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Concerto		
▲ 9.5" mono display		
▲ 2 PCMCIA Type II slots		
▲ Integrated, detachable keyboard		
Processor	Hard Drive	Price*
486SL/25	120MB	\$2359
486SL/25	250MB	\$2649
486SL/33	250MB	\$2929

Lease for \$87/mo.



Concerto

LTE Lite 4/25		
Screen	Hard Drive	Price
Monochrome	120MB	\$1999
Monochrome	209MB	\$2349
Active Mono	120MB	\$2799
Active Mono	209MB	\$3099

Lease for \$73/mo.

Centura 4/25

Screen	Hard Drive	Price
Mono	209MB	\$2199
Dual Scan	209MB	\$2599
Active Matrix	209MB	\$3449

Lease for \$81/mo.

Canon

NoteJet 486c		
▲ 2 PCMCIA Type II Slots		
▲ Built-in Inkjet printer:		
▲ 360dpi resolution		
▲ Automatic sheet feeder included		
▲ Dual scan STN color		
Processor	Hard drive	Price*
486SX/25	120MB	\$2839*
486SX/25	200MB	\$3169

Lease for \$104/mo.



NoteJet

BubbleJet Printers		
BJ10sx-portable	110cps, 3.7lbs	\$259.99
BJ200e, desktop	248cps	\$299.99
BJ230, 11"x17" capacity		\$419.99
BJC600, Color inkjet, 360dpi		\$589.99

2-year warranty included

\$2839*

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Bravo NB			
▲ 486SX/25 processor			
▲ Accelerated local bus graphics			
▲ PCMCIA Type III slot			
Screen	Model	Hard Drive	Price*
Mono	123W	120MB	\$1449*
Mono	173W	170MB	\$1539
Dual scan	123W	120MB	\$2279
Dual scan	173W	170MB	\$2399
Active matrix	173W	170MB	\$2899

Lease for \$53/mo.



Bravo NB

PowerExec		
Model	Screen	Price
4/25SL Model 203/W	Mono	\$1979
4/25SL Model 203/W	Active color	\$3699
4/33SL Model 203/W	Mono	\$2259
4/33SL Model 203/W	Active color	\$3899
4/33SL Model 343/W	Active color	\$4299

Lease for \$73/mo.

\$1449*

AST
Authorized Systems
Reseller

Bravo LC		
▲ 4/8MB RAM exp. to 64MB		
▲ 120/170/210MB hard drive		
Model	Hard Drive	Price*
4/25s Model 123W	120MB	\$949
4/33 Model 123W	120MB	\$1279
4/33 Model 173W	170MB	\$1329
4/33 Model 213W	210MB	\$1539
4/66d Model 213W	210MB	\$1979

*Monitors sold separately
Lease for \$50/mo.

Bravo LC

Bravo MT		
Model	Hard Drive	Price*
4/33 Model 3	Optional	\$1239
4/33 Model 173W	170MB	\$1519
4/33 Model 343W	340MB	\$1979
4/66d Model 3	Optional	\$1659
4/66d Model 173W	170MB	\$1929
4/66d Model 343W	340MB	\$2399

*Monitors sold separately

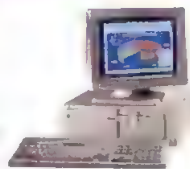
Lease for \$50/mo.

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VL Bus Desktops		
Processor	Hard drive	Price*
486SX 25	170MB	\$919
486SX/33	170MB	\$1009
486DX/33	260MB	\$1249
486DX2/50	345MB	\$1609
486DX2/66	345MB	\$1699

*VGA color monitors begin at \$209.99

Lease for \$50/mo.



VL Bus Desktops

VL Bus Minitowers		
Processor	Hard drive	Price*
486DX/33	260MB	\$1309
486DX2/50	345MB	\$1669
486DX2/66	345MB	\$1839

*VGA color monitors begin at \$209.99

WinPro 486SLC Series

Processor	Hard drive	Monitor	Price*
486SLC33	120MB	14" VGA	\$979
486SLC33	170MB	14" SVGA	\$1059

New Media

Visual Media SCSI PCMCIA Adapter	\$219.99
WAVjammer PCMCIA sound card	\$279.99
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DoubleCase NB-5060	\$149.99

Epson

Action Printer 3260, 24 pin, color	\$199.99
LQ570+, 24 pin, 337cps	\$254.99
LQ 870, 24 pin, 413cps	\$459.99
Stylus 800 Inkjet, 180cps	\$299.99*

*\$25 rebate available 3/1 to 5/31/94

Angia

SafeJack 19.2/14.4, SJ192	\$319.99
PCMCIA 16mm 14.4/14.4, PCM144T	\$319.99
PCMCIA 14.4/14.4, PCM144	\$289.99
14.4/14.4 I/Compaq, FM144CPQ	\$349.99
24/96 I/Compaq, FM24CPQ	\$149.99

Plicson

14/4/14.4 PCMCIA w/SmartConnect	\$289.99
96/96 PCMCIA	\$259.99
24/96 PCMCIA	\$179.99
24/96 I/Compaq	\$99.99
96/96 I/Compaq	\$329.99
14/4/14.4 I/Compaq	\$359.99

Maxtor

PCMCIA, 105MB Drive, Type III	\$469.99
DeskRunner, Drive Bay Adapter	\$139.99
130MB IDE Drive	\$199.99
245MB IDE Drive	\$249.99
345MB IDE Drive	\$309.99

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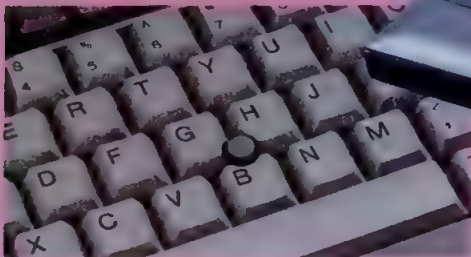
Toshiba Direct

Portégé T3400

- ▲ Ultra-portability at only 4.1 lbs. (4.4 lbs. for color) and 9.9"W x 7.9"D x 1.7"H
- ▲ 486SX/33 processor
- ▲ 120MB hard drive
- ▲ 4MB RAM, expandable to 20MB
- ▲ PCMCIA Type II slot
- ▲ External 3.5" disk drive
- ▲ Integrated AccuPoint™ pointing device

Screen	Price
Monochrome	\$2259*
Active color	\$3469

Lease for \$82/mo.*



AccuPoint pointing device

\$2259*

T3400 Color

T4700

- ▲ 486DX2/50 processor
- ▲ 8MB RAM, expandable to 24MB
- ▲ Brilliant 9.5" display with local bus video
- ▲ 2 PCMCIA slots (1 Type II, 1 Type III)
- ▲ Microsoft Sound System, built-in microphone, audio out port
- ▲ MS-DOS, Windows 3.1, UltraFont & Indeo video compression software

Screen	Hard drive	Price
Dual scan color	200MB	\$3999*
Dual scan color	320MB	\$4329
Active color	200MB	\$4599
Active color	320MB	\$4949

Lease for \$147/mo.

\$3999*



T4700 Dual Scan

T1910

- ▲ 486SX33 processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 9.5" display
- ▲ Type III PCMCIA slot
- ▲ 82-key keyboard
- ▲ MS-DOS, Windows 3.1
- ▲ Ballpoint mouse 2.0 with Quickport
- ▲ Enhanced power management

Model	Screen	Hard drive	Price
T1910	Monochrome	120MB	\$1499
T1910	Monochrome	200MB	\$1729
T1910	Dual scan color	120MB	\$2099
T1910	Dual scan color	200MB	\$2329

Lease for \$55/mo.

\$1499

T1950

- ▲ 486DX2/40 processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 9.5" display
- ▲ Type III PCMCIA slot
- ▲ 82-key keyboard
- ▲ MS-DOS, Windows 3.1
- ▲ Ballpoint mouse 2.0 with Quickport
- ▲ Enhanced power management

Model	Screen	Hard drive	Price
T1950	Monochrome	120MB	\$1899
T1950	Monochrome	200MB	\$2099
T1950	Dual scan color	120MB	\$2499
T1950	Dual scan color	200MB	\$2719
T1950	Active color	120MB	\$2849
T1950	Active color	200MB	\$3069
T1950	Active color	320MB	\$3399

Lease for \$70/mo.

\$1899

T4600

- ▲ 33MHz 486SL processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 9.5" display
- ▲ 2 PCMCIA slots
- ▲ Ballpoint mouse with QuickPort
- ▲ MS-DOS 6.0, Windows 3.1

Screen	Hard drive	Price
Monochrome	200MB	Call
Active color	120MB	\$3889
Active color	200MB	\$4099
Active color	320MB	\$4449

Lease for \$143/mo.

\$3889

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Desk Station IV

Toshiba's Desk Station IV turns your T4600, and T4700 into a full-function desktop computer by providing:

- ▲ 2 full-size, 16-bit industry standard expansion slots
- ▲ 5.25" half-height drive bay
- ▲ Parallel, serial, PS/2 mouse, VGA monitor, 101-key keyboard ports and 1 floppy disk drive port
- ▲ Separate monitor stand
- ▲ Monitor, notebook and keyboard extra

\$599⁹⁹



Texas Instruments



\$4399*

4000E WinDX4/75 Active Matrix

- ▲ 4MB RAM expandable to 20MB
- ▲ 8.4" or 9.5" active matrix color display
- ▲ 16KB cache
- ▲ 340MB/450MB hard drive
- ▲ New Intel DX4 chip

Display	Hard drive	Price
8.4" active matrix color	340MB	\$4399
9.5" active matrix color	450MB	\$4849

4000E WinSX/25

- ▲ 486SX/25 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 10" monochrome display
- ▲ 120MB hard drive
- ▲ Enhanced high-speed video
- ▲ MS DOS 6.0, Windows 3.1

Lease for \$62/mo.

\$1679



4000E WinSX/25 Color

- ▲ 486SX/25 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 8.2" enhanced color display
- ▲ 120MB hard drive
- ▲ Enhanced high-speed video
- ▲ MS DOS 6.0, Windows 3.1

Lease for \$77/mo.

\$2099



4000E WinDX2/50

- ▲ 486DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 10" monochrome display
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ MS DOS 6.0, Windows 3.1

Lease for \$89/mo.

\$2429



4000E WinDX2/50 Dual Scan Color

- ▲ 486DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 9.4" dual scan color display
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ MS DOS 6.0, Windows 3.1

Lease for \$110/mo.

\$2999



4000E WinDX2/40 Color

- ▲ 486DX2/40 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 8.2" enhanced color display
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ MS DOS 6.0, Windows 3.1

Lease for \$99/mo.

\$2699



4000E WinDX2/50 Active Matrix

- ▲ 486DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 8.4" active matrix color display
- ▲ 200MB hard drive
- ▲ Enhanced high-speed video
- ▲ 4mm full travel keyboard
- ▲ MS BallPoint with QuickPort
- ▲ MS DOS 6.0, Windows 3.1

Lease for \$125/mo.

\$3799



TravelMate Intelligent Docking System

Instantly transforms your TravelMate notebook into a full-sized, full-featured 486 desktop PC

\$799.⁹⁹



WinDX2/50
August 1993



WinSX/25
August 1993



WinSX/25 Color
August 1993

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View the latest in the line of award-winning monitors, which include a 3-year warranty!

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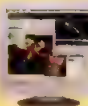
- ▲ 15" SVGA
- ▲ 1024x768, .28mm ni
- ▲ 72MHz VESA refresh rate
- ▲ MPR II, EnergyStar compliant
- ▲ Great for Entry-level business/Windows applications



\$519.99

5FGp

- ▲ 17" SVGA
- ▲ 1280x1024, .28mm ni
- ▲ Opticlear surface
- ▲ Intelligent Power Management System
- ▲ Great for entry-level CAD, color desktop publishing



\$1219.99

6FGp

- ▲ 21" SVGA
- ▲ 1280x1024, .28mm ni
- ▲ Opticlear surface
- ▲ Intelligent Power Management System (IPM)
- ▲ Great for professional CAD/CAM/CAE, graphic design, color desktop publishing

\$2369.99

NEC

UltraLite Versa E

- ▲ 486 processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball

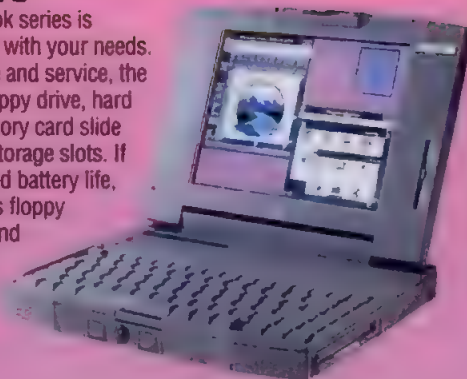
Processor	Screen	Hard drive	Price
DX2/40	Active color	120MB	\$3819
DX2/40	Active color	250MB	\$4229
DX2/50	Monochrome	209MB	\$3259*
DX2/50	Active color	209MB	\$4499
DX2/50	Active color	340MB	\$4919

Lease for \$120/mo.

\$3259*

UltraLite Versa E

The Versa E notebook series is upgradable to grow with your needs. For ease of upgrade and service, the UltraLite Versa's floppy drive, hard disk drive and memory card slide in and out of their storage slots. If you require extended battery life, slide out the Versa's floppy drive, pop in a second battery, and double your time on the road.



Ready Multimedia Desktops

Get Ready for an impressive multimedia system from NEC. The Ready 425CD2 and Ready 433CD3 feature built-in ready-to-run CD-ROM readers, a complete sound system, and a comprehensive software offering to introduce you to multimedia computing. Also sporting local bus graphics and 24-bit true color, the multimedia Ready will speed through your applications and display them in bright, clear colors.



Ready Multimedia Desktops

- ▲ 4MB RAM expandable to 36MB
- ▲ 9600/4800 fax, 2400 data modem
- ▲ Local bus graphics
- ▲ Fast double or triple speed CD-ROM
- ▲ MediaVision 16-bit stereo sound
- ▲ Labtec speakers, headphone, and microphone
- ▲ MS-DOS 6.0, Windows 3.1, America-On-Line, CompuServe
- ▲ CD-ROM titles include: PFS: Window Works, Compton's Encyclopedia, Dinosaur Adventure and Space Adventure

Processor	Hard drive	Price
486SX/25	170MB	\$1499*
486SX/33	250MB	\$1899

NEC SVGA monitor \$319.99

Lease for \$55/mo.

\$1499

PowerMate Desktops

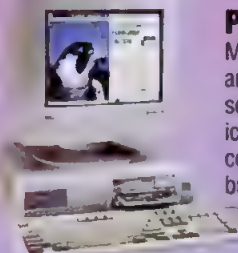
- ▲ 4MB RAM expandable to 36MB
- ▲ 8KB cache expandable to 256KB
- ▲ Local bus True Color video
- ▲ Graphics accelerator
- ▲ 3 expansion slots, 3 drive bays
- ▲ MS DOS, Windows 3.1, NEC mouse

Processor	Hard drive	Price
486SX/33	170MB	\$1129
486DX2/50	210MB	\$1399
486DX2/66	210MB	\$1749

NEC SVGA monitor \$319.99

Lease for \$55/mo.

\$1129



PowerMate Desktops

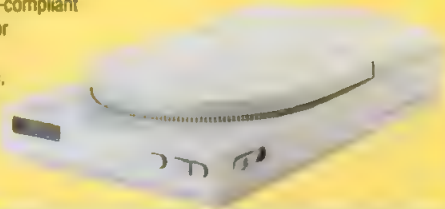
Meeting your needs for aggressive pricing and outstanding quality, the PowerMate 486 series features local bus video and a graphics accelerator to deliver falcon-like speed. By combining 486 processing power with local bus video and True Color support, the PowerMate takes you to new heights in performance.

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New from NEC—the fastest CD-ROM Drives available

- ▲ Triple speed 450Kb/sec transfer rate, 195ms access time & 256K buffer
- ▲ MPC Level 2 compliant, Multisession Photo CD & XA-compliant
- ▲ Sleek new design features front panel LCD controls for display of data, audio & diagnostics data
- ▲ Full audio control buttons (play, repeat, track advance, pause, stop) on front panel for your music CDs. And play audio CDs without a PC.

MultiSpin 3Xp Portable Drive	\$429.99
MultiSpin 3Xi Internal Drive	\$479.99
MultiSpin 3Xe External Drive	\$569.99



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- ▲ 4MB RAM expandable to 64MB
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- ▲ 3.5" 1.44MB disk drive
- ▲ 2 Serial, parallel, keyboard, mouse ports
- ▲ IBM enhanced keyboard, IBM Mouse

You can't beat the ValuePoint SpaceSaver if you're looking for IBM quality, service and support at an entry level price.

With lots of room for expansion, here's a system you won't grow out of in 2 years.

The most flexibility offered in any configuration featuring 8 expansion slots and 6 drive bays.

The ultimate power trip is here in a Pentium system featuring PCI architecture. Run LANs, graphics, publishing, CAD/CAM and more at a full-tilt 32-bit speed.

- ▲ Based on the IBM ValuePoint config.
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- ▲ IBM internal double speed CD-ROM
- ▲ Creative Labs stereo speakers & microphone
- ▲ 10 CD-ROM titles: Kodak Photo CD Access, Software Toolworks Multimedia Encyclopedia, Multimedia Microsoft Works, Microsoft Bookshelf, HSC Interactive Presentation Tool, Just Grandma & Me, Where in the World is Carmen Sandiego?, Loom, The Secret of Monkey Island, Secret Weapons of the Luftwaffe

Processor	Hard Drive	Price
486DX/33	212MB	\$2049
486DX2/66	340MB	\$2649
486DX2/66*	340MB	\$2469

*Excludes speakers, microphone and CD-ROM software titles. Other models available.

ValuePoint Models and Specifications

Model	Hard Drive	Video	Slots	Bays	Software	Price
ValuePoint Si SpaceSavers (Video RAM expandable to 1MB)						
486SX/25	120MB	512K	3	3	IBM DOS/MS Windows	\$929
486DX/33	212MB	512K	3	3	IBM DOS/MS Windows	\$1399
486DX2/66	212MB	512K	3	3	IBM DOS/MS Windows	\$1789

ValuePoint Desktops (ZIF socket, Pentium OverDrive upgradability, VESA local bus slot)

486SX/33	170MB	1MB	5	5	IBM DOS/MS Windows	\$1359
486DX/33	212MB	1MB	5	5	IBM DOS/MS Windows	\$1559
486DX/33	340MB	1MB	5	5	IBM DOS/MS Windows	\$1719
486DX2/66	340MB	1MB	5	5	IBM DOS/MS Windows	\$2159

ValuePoint MiniTower (527MB system includes 8 MB RAM standard)

486DX2/66	340MB	1MB	8	6	IBM DOS/MS Windows	\$2269
486DX2/66	527MB	1MB	8	6	IBM DOS/MS Windows	\$2699

ValuePoint P60/D Pentium (features 32-bit PCI architecture, 16MB RAM expandable to 128MB, 256KB cache, Intel PCI local bus with 3 available PCI local bus slots)

Pentium 60MHz	424MB	1MB	4	5	none	\$4039
Pentium 60MHz	525MB	1MB	4	5	none	\$4099

*Monitors priced separately. Other models available.



Luxurious Leather
\$99.99

- Padded computer section with divider
- 3 section compartment for files
- Pockets for disks, pens, & business cards
- External pocket 13" x 9" x 2"

Also from Targus

Prestige Leather (3 colors)	\$224.99
Business Traveler	\$199.99
Premier Leather	\$139.99
Business Commuter	\$124.99
Universal Case	\$69.99
Notepad (5 colors)	\$39.99



Lifetime Replacement Warranty



XJACK
14.4/14.4
\$299.99

Model	Price
XJ1144 14.4/14.4	\$299.99
XJ196FM 96/96	\$239.99
XJ124FM 24/96	\$179.99
CC3144 14.4/14.4	\$299.99
CC396FM 96/96	\$239.99
CC324FM 24/96	\$179.99



PS/Note



PS/Note notebooks

- ▲ 486SL20 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 125MB hard drive
- ▲ Local bus graphics
- ▲ 9.2" passive color with 256 colors at 640x480
- ▲ 8.5" monochrome with 64 grays at 640x480
- ▲ MS-DOS, MS Windows, MS-Works, America-on-Line, + more software

Screen

Monochrome
Color

Price

Call for price
Call for price



ValuePoint Desktop

ThinkPad 500 subnotebooks

Lighten your load. Increase your power.

- ▲ 486SLC2/50 processor
- ▲ 4MB RAM exp. to 12MB
- ▲ 170MB hard drive
- ▲ 7.4" VGA monochrome display
- ▲ Serial, enhanced parallel, monitor, keyboard, mouse, external disk drive ports
- ▲ 1 Type II PCMCIA slot
- ▲ 81-key keyboard
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive included
- ▲ NiMH battery, AC adapter
- ▲ Weighs only 3.8 lbs. (w/battery) and measures 10.11" x 7.23" x 1.63"
- ▲ IBM DOS 6.1, Prodigy

\$2419*



ThinkPad 500



Authorized Personal Computer Dealer



Okidata
OL400e
\$499.99

- 4PPM, 300dpi
- 44-bit-mapped fonts
- Energy Star



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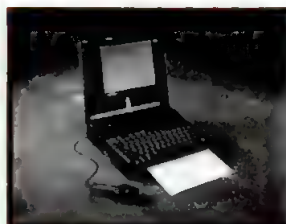
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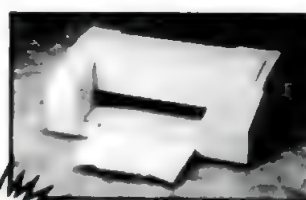
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Canon NOTEJET 486 - SLC/25

- 486 SLC/25 Mhz
- Built-In "Bubble-Jet" printer
- 4 MG Ram
- 85 MG - \$2139 • 135 MG - \$2349
- 180 MG - \$2549



Epson Stylus 800—\$255*



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3C503/5-pack	179/789
3C503TP 10 Base T	219
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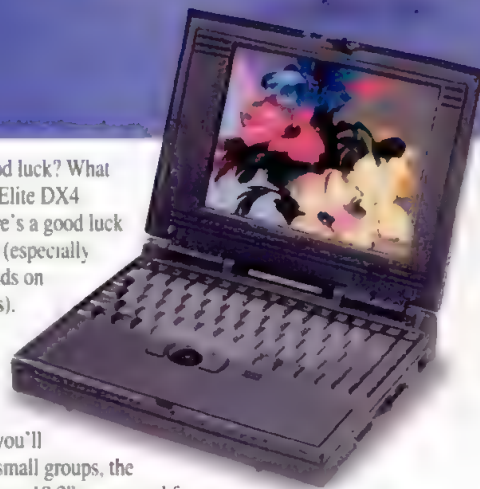
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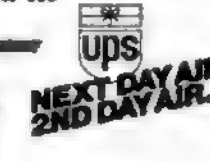
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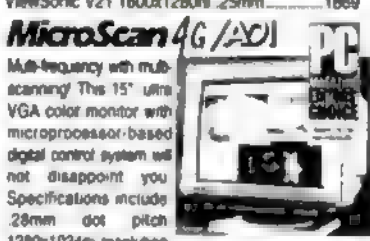
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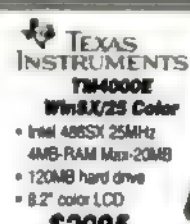
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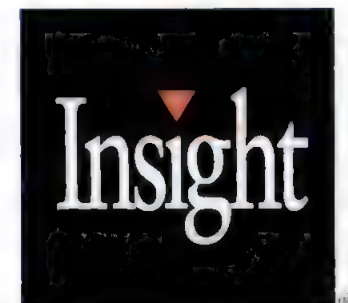
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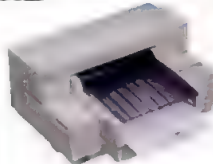
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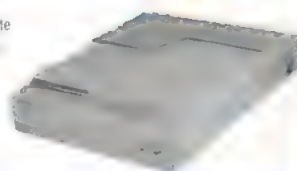
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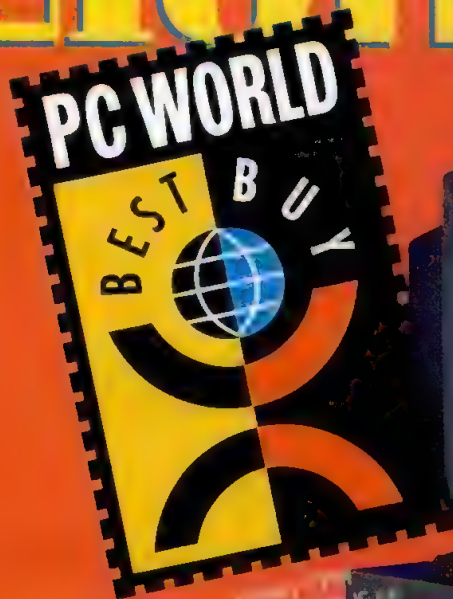
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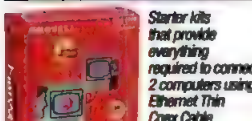
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- Monochrome VGA Monitor
- IDE VL-BUS Adapter

\$1995 486 526MHz VL-LOCAL BUS

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- 256K RAM Cache
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How PC Direct Helped Computer Discount Warehouse Found "Customer University"

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University—which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell—and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a \$10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it—closing rate, calls per ad dollar—PC Magazine is tops."

If you're a direct marketer and you're looking for one million prospects who understand value and service, look no further than PC Direct. There's no better way to attract so many loyal, repeat customers.



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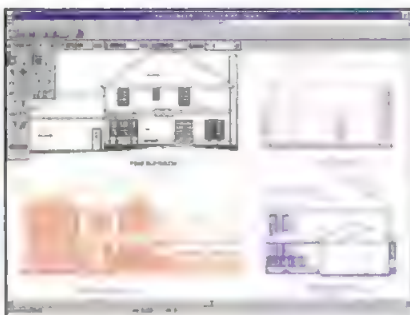
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CIRCLE 025 ON READER SERVICE CARD



PC
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CHOICE

December 17, 1991

When Midwest Computer Works made PC Direct their driving force, sales took off at top speed.



When Midwest Computer Works opened for business in 1989, co-founders Steve Melnick and Susan Freed had a vision of one day becoming a successful global enterprise. They made this happen by embracing a customer-oriented philosophy and by specializing in networking and laptops. Whether it's shipping orders the same day they're ordered, offering easy access to technical support from certified Netware engineers, or upgrading the telephone systems so every call is answered by a real-live person, Midwest Computer Works works.

In fact, it's working so well that they're preparing for a massive growth period. Steve Melnick says, "We've redesigned our infrastructure to handle it so that we're ready to now increase our staff and almost double the size of the company." Obviously, Midwest Computer Works' approach and its 100% commitment to its customers paid off. And of course, it didn't hurt that they selected a winning media strategy.

Even though they started small, they didn't let size stand in the way of their big dreams. "We started from nothing and went right into PC Magazine," says Melnick. "And we found instant success from that. Which is part of the reason why we're so successful today, because we didn't start with some of the smaller magazines trying to work our way up."

"We decided that we wanted to be a major player in the mail order business in the United States. And in order to do that, when we did our research, it showed that PC Magazine was the place to be. The response has been great. We've noticed an increase in our business based on the amount of subscribers that have been added."

With PC Magazine, "Your return on your investment is the highest, because you see immediate results. PC Magazine was our first buy. And from day one, it gave us credibility and great response. When you commit to every issue, customers soon realize you're a sizable company and here to stay. We've moved to two pages in PC Direct. It's where business buyers shop for their favorite vendors. And with twice the ad space, we're bracing for warp speed."

Move your sales into high gear. If you're a direct marketer with a breakthrough idea, bring it to the attention of 1,000,000 of the most active and knowledgeable PC buyers. Call your PC Magazine sales representative or 212-503-5100 and get the facts about PC Direct.



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- *Start-Up City*, an exhibit area dedicated to showcasing innovative new products and solutions from emerging companies.
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- *CNEPA Labs*, a forum for the transfer of technical information from the vendors to the network computing professional.

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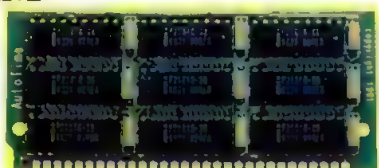
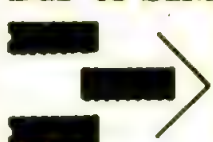
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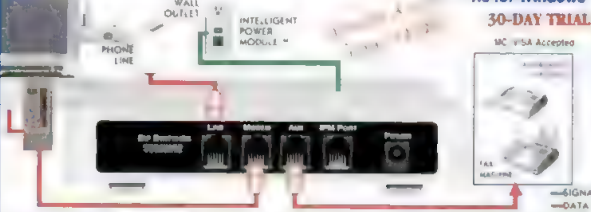
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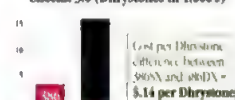
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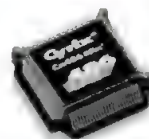
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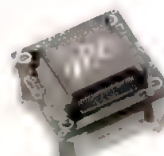


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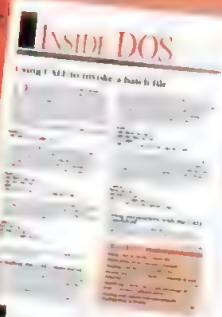
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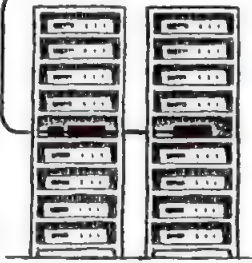
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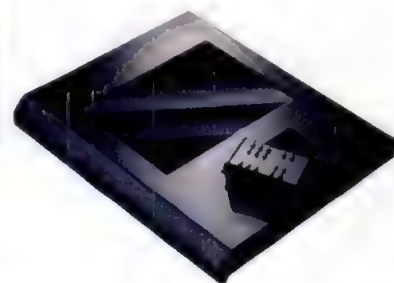
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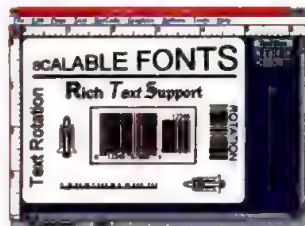
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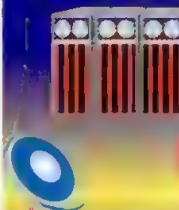
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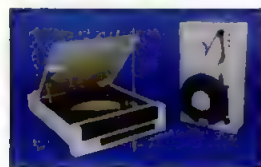
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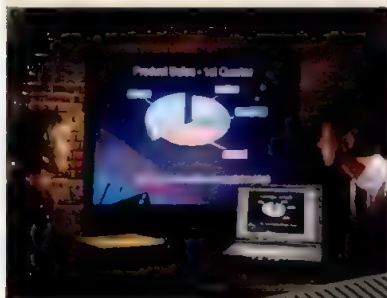
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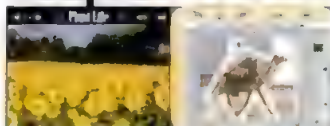
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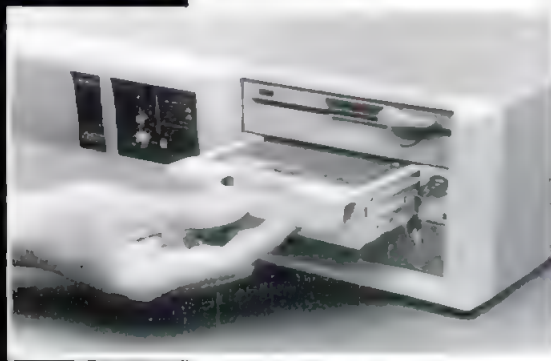
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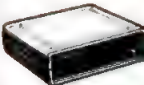
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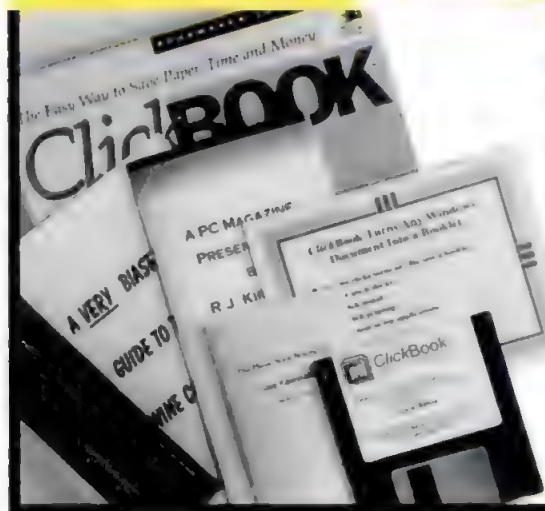
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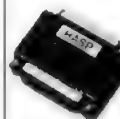
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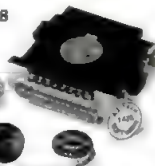
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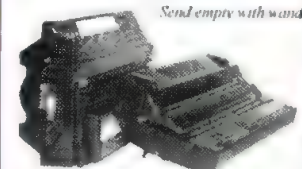
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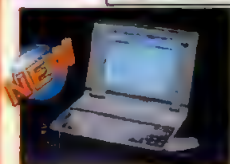


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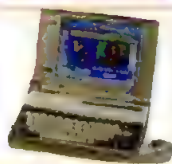
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T1910CS	i486SX/33	4/20	9.5" Dual Scan Color	Type IV	6.6	100MB	\$1207.55	35982
						200MB	\$1217.11	35983
T1950	i486DX2/40	4/20	9.5" 64 Gray Scale LCD	Type III	6.6	120MB	\$1188.10	31928
						200MB	\$1197.66	31929
T1950CS	i486DX2/40	4/20	9.5" Dynamic STN Color	Type III	6.9	120MB	\$1197.66	31930
						200MB	\$1207.22	31932
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T1950CT	i486DX2/40	4/20	8.4" Active matrix Color	Type III	6.9	200MB	\$1207.22	32043
						320MB	\$1216.78	32044
T3400	i486SX/33	4/20	8.4" 64 Gray Scale LCD	1) IV or 2) II	4.1	120MB	\$1197.66	33634
T3400CT	i486SX/33	4/20	7.8" Active Matrix Color	1) IV or 2) II	4.4	120MB	\$1207.22	33635
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Data Compression (V.42bis, MNP 5)	✓	✓	✓	✓
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851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
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951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000

1. Do you work in a DP/MIS dept.?
01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity. (Check one)

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- 02. ☐ Manufacturer-Aerospace
- 03. ☐ Manufacturer-Other
- 04. ☐ Systems House
- 05. ☐ Computer Consultant
- 06. ☐ Computer Retailer/VAR/VAD Distributor
- 07. ☐ Communications
- 08. ☐ Finance/Banking/Insurance/Real Estate/Accounting
- 09. ☐ Education
- 10. ☐ Government
- 11. ☐ Research and Development
- 12. ☐ Data Processing/Computer Service
- 13. ☐ Health/Medical/Legal Service
- 14. ☐ Engineering/Architecture

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- 10. ☐ Production
- 11. ☐ Education/Training
- 12. ☐ Marketing/Sales
- 13. ☐ Medical/Legal
- 14. ☐ Admin./Mgmt.

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

- 01. ☐ 10 or less 03. ☐ 26-99
- 02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

- 01. ☐ Linked to mainframe
- 02. ☐ Linked to mini
- 03. ☐ Networked together

7. Please check the equipment currently installed at your location. (Check all that apply)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Mins
- 04. ☐ Macintosh
- 05. ☐ CD-ROM
- 06. ☐ Windows

8. Do you plan to buy any PC products?

- 01. ☐ Now 03. ☐ In 7 to 12 months
- 02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:

- 01. ☐ 25 or less 03. ☐ 100-499 05. ☐ 1000 or more
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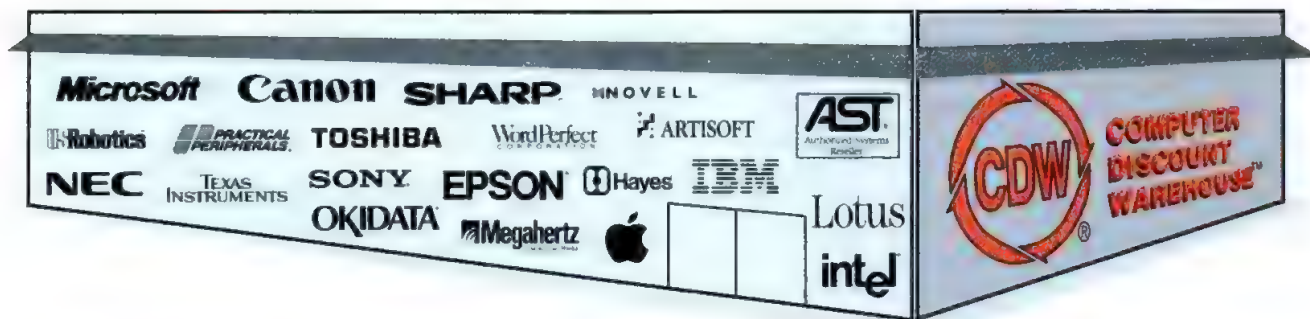
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Coming Up

Power to the PC

Is it possible to have a PC that's energy-efficient yet still has the power to blast through the most demanding software? *PC Magazine* tests 31 of today's new generation of PCs. All are mainstream units aimed at users ranging from first-time buyers to power pros, and all and meet the Environmental Protection Agency's Energy Star guidelines.

Peer-to-Peer Networks

Often the first step in linking your office computers is a peer-to-peer network. Now this market, traditionally a lower-cost alternative to server-based LANs, is stratifying into simple, low-cost packages at one end and, at the other, into more complex offerings that handle more nodes, include e-mail, and connect to NetWare. Some high-end packages even position themselves as a choice against NetWare 3.12. We test 13 solutions to recommend the best starting point for the well-connected office.

Video Capture and Editing Tools

Full-motion video on the PC sounds great. You capture it, edit it, and voilà—it's MTV, right? Not exactly. Still, it may be the perfect medium to spice up your presentation or enliven a kiosk. To help you lay the groundwork for video on the PC, we suggest minimum hardware requirements, examine eight video capture boards under \$700, and look at some of the best video-editing software products available for the PC today.

Low-Cost Integrated Software

Since our last look at low-cost integrated software more than 18 months ago, these packages have changed dramatically: They're finally delivering the right tools for sharing data. We take a close look at five graphical Windows- or OS/2-based packages—each with at least a word processor, spreadsheet, and database—that integrate essential features at downright affordable prices.

Utilities

It's an immutable law of nature: Data and programs constantly expand to fill up all available disk space. A helpful utility named DiskPie lets you identify the biggest consumers of space on your disk. Want to know how much hard disk real estate you've given up to store all those .GIF files? Is half of your C: drive devoted to the C:\GAMES directory? Is that PCX picture really worth a thousand kilobytes? Use DiskPie's colorful charts and reports to find out.

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Service
No.**

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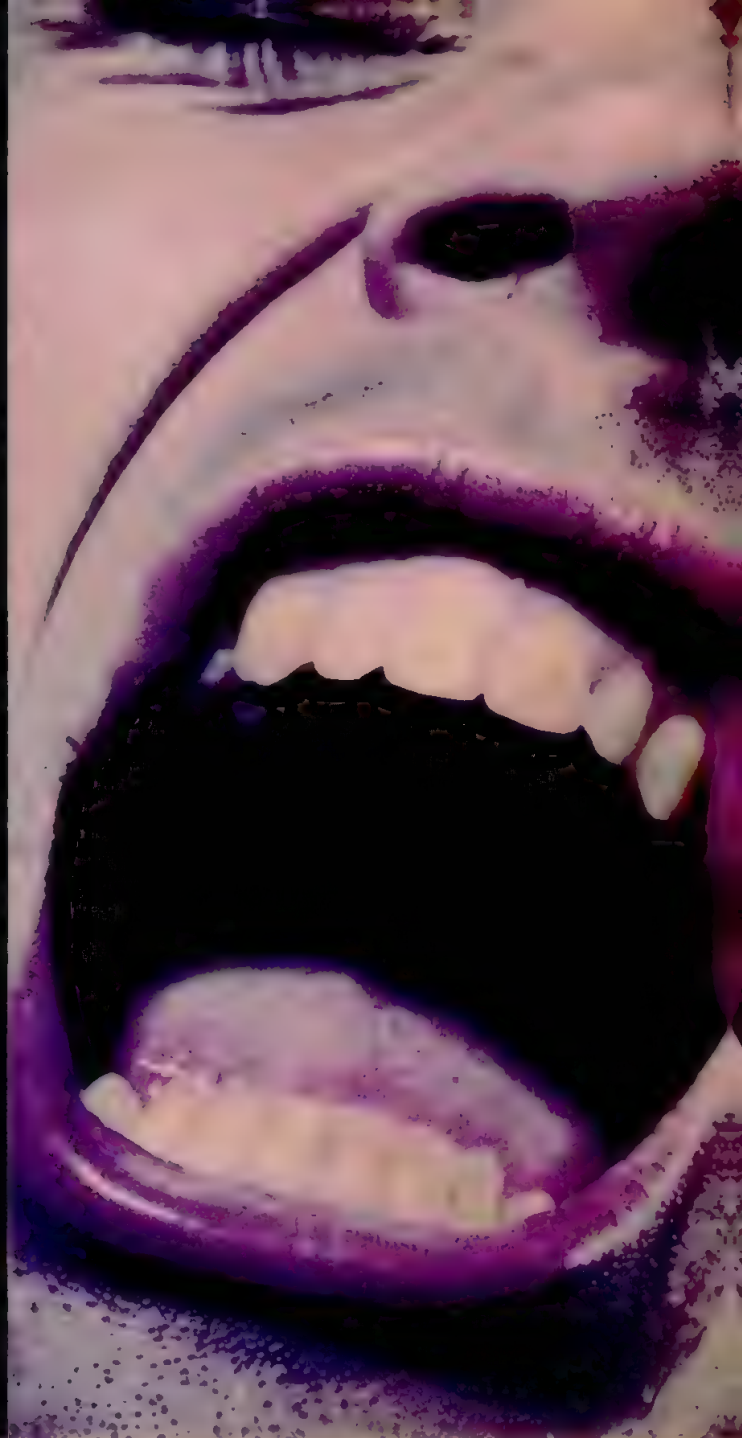
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CIRCLE 355 ON READER SERVICE CARD



Micro

After Hours

On-Line: Chatting on America Online, CompuServe Information Service, and The ImagiNation Network;

On-Line: Real-Time Gaming in Cyberspace; **CD-ROM Pick-Hit:** Plan-It Earth;

Games: The Hand of Fate; **Spotlight on Shareware:** DOOM and Blake Stone: Aliens of Gold

ON-LINE

Looking for Friends in Some Unusual Places

BY ANGELA GUNN

Hanging out on-line used to be what some people did in lieu of having a life. But these days everybody is poking around in cyberspace, and the largest on-line services (as well as the Internet) provide real-time chat that rivals, if not Noël Coward, the kind of entertaining banter that makes life more interesting.

America Online (AOL), CompuServe Information Service (CIS), and The ImagiNation Network (INN; née The Sierra Network) all offer on-line hangouts where like-minded souls can seek same for games, conversations, or maybe even love. Certainly the history of on-line entertainment passed some sort of milestone one weekend in late 1993, when on a single night on America Online you could channel-surf between tarot readers, "hot talk," and a Q-

and-A with the Rev. Billy Graham.

Deciding which on-line service will best suit your chatting desires is like choosing be-

mercial on-line services, you can try your hand at the free-for-all that is the Internet. There you'll find myriad chat and gaming opportunities in the MUDs and MUGs (multi-user dimensions and games, respectively) that dot the landscape. The Internet doesn't have an overall "atmosphere" as the services do, though; and finding what—or who—you're looking for may take some searching.



'TOON TIME: On The ImagiNation Network, your chat buddies are more than just some nameless faces.

tween Las Vegas and Disneyland: It depends on your sensibility. Like different social venues, each system has its own flavor, preferred activities, and culture.

In addition to these com-

the information highway"—but it's no more offensive than other services.

Chatting here works much the same way as it does on other services: You enter the chat area through a main group, or "lobby." You can stay and participate in the general discussion in this area or scan the list of group names to find a chat ("room") that looks appealing.

When you enter a room, your name is broadcast to the other participants, and you're ready to start sending public or private messages. If so inspired, you can invite friends to withdraw to a private room to talk or create your own public salon.

AOL also offers a number of on-line "speakers"—guests who log on and answer questions from whoever is assembled to watch the session scroll by. Other AOL chats are less organized but still enthusiastically attended; a number of bulletin-board messaging groups on AOL supplement their postings with regular meetings.

Where AOL prominently features its chats, CompuServe downplays its own. Plenty of regular CIS users don't know or care that CB Simulator is available at all times. Nonetheless, CB is well populated with voluble users, and with 35 available channels on each of the CB Simulator sections, you'll be able to stake out and name your own cyberturf temporarily. CompuServe isn't as easy to navigate as AOL, but it does

WHAT IT'S LIKE UP THERE

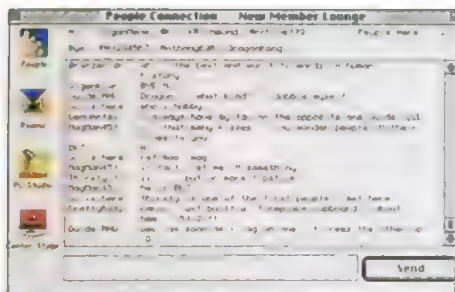
America Online offers the most diverse and free-wheeling on-line chat areas. Because of this, AOL has gotten a raunchy reputation—it's been called a "sleazy truck stop on

America Online. Software: free; subscription price: \$9.99 per month for the first 5 hours, \$3.50 for each additional hour. America Online Inc., 8619 Westwood Center Dr., Vienna, VA 22182; 800-827-6364, 703-448-8700; fax, 703-883-1509. Circle 509 on reader service card

CompuServe Information Service. Software: \$39.95, with \$25 usage credit; subscription price: \$8.95 per month, plus \$4.80 per hour. CompuServe Inc., Membership Sales, P.O. Box 20212, Columbus OH 43220; 800-848-8199. Circle 510 on reader service card

The ImagiNation Network. Software: free; subscription price: \$9.95 per month for 5 hours, \$3.50 each additional hour. The ImagiNation Network, 41486 Old Barn Way, Oakhurst, CA 93644; 800-462-4461; fax, 209-642-0888. Circle 511 on reader service card

After Hours



MAKING FRIENDS: On America Online, the chat is diverse and froewheeling.

allow you to monitor the activities in several rooms besides your own.

The third service, INN, feels like a cruise ship; whether it's the Love Boat or the Good Ship Lollipop is up to you. Here, you're more than just a name: When you log on you construct a 'toon—a cartoon representation of your real or ideal self—that can be seen by the other players. Chatting is available in all the gaming areas, as well as in the chat rooms and conference rooms. To talk to someone you simply start typing. Which area you're in will largely determine the nature of the chat: In the adults-only area, CasinoLand, you're as likely to have someone ask if you've ever wrestled a man for money as you are to be questioned about the weather.

INN is also the real-time component of Prodigy, the biggest on-line service of all.

The INN gateway, called GamePoint, offers the INN games and supports 'toons.

GETTING SOME CULTURE

Many of the adults and teenagers logging onto these services are looking for a particular

kind of chat that the Rev. Graham would not be particularly comfortable with. For those looking for love and other diversions on-line, there are a few things you should know to make your time on-line more successful.

First, the male/female ratio, while improving, is still tilted toward the male side. This produces a double bind: Women who want to hang out quietly will be deluged with messages ranging from charming to gross, and men hoping to talk with women often can't buy a break. Since handles or 'toons don't necessarily reflect the true description of the participant, any given on-line session will include women disguised as men (for a little peace) and men disguised as women (for a lot of attention).

Second, the three services differ in the way they position

their chat sections. Only AOL and CIS offer areas specifically for lesbian or gay chat. All three services have "adult" sections, but AOL doesn't self-segregate those areas (unlike CIS's adult CB channels or INN's CasinoLand). Here, as with all the services, the best approach is to monitor your children's on-line activities so they don't get into something they shouldn't. And while all the services have kids-only

areas, the strong graphics and wealth of games make INN's the most appealing.

It can be difficult to establish which service fits you without spending time on each of them. No two people will have the same experience entering an on-line community, just as no two would have the same experience moving to a new city. Just wander around until you feel at home.

ON-LINE

Real-Time Gaming in Cyberspace

BY ANGELA GUNN

Idle chatter is fun, but maybe you'd like something livelier. All the on-line services represented here feature real-time games that pit you against other players. Here's a brief look at a few of the offerings.

The ImagiNation Network, with roots in Sierra On-Line software, offers the best variety of on-line games. Shadow of Yserbius and Fates of Twin-ion, the fantasy role-playing options, are also popular disk-based games. For sports enthusiasts, INN offers 3-D Golf



ATTACK: INN's Shadow of Yserbius brings adventuring on-line.

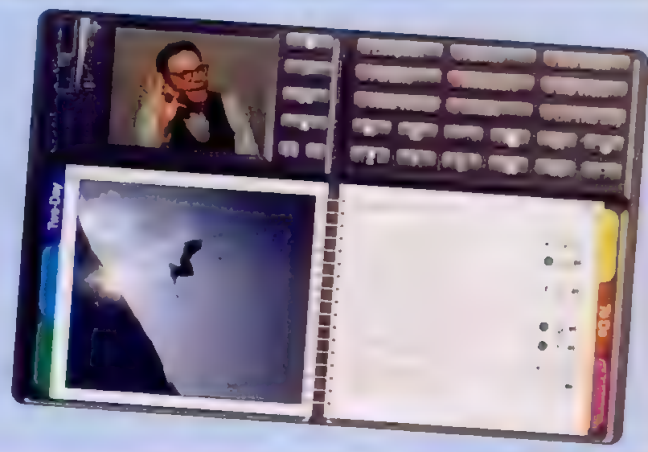
and MiniGolf, both of which are multiuser, real-time games. For those seeking more standard fare, INN offers parlor favorites such as checkers and chess, as well as offbeat

Plan-It Earth Pulls Out All the Multimedia Stops

If you've been longing for a multimedia application that combines fun with everyday utility, look no further. This personal information manager (PIM) gives you all the capability of a standard planner dressed up with some multimedia bells and whistles. And the best part is that you can update your appointments without hitting a single key, thanks to the voice recognition capabilities. Each day starts with a wildlife image and a nature video.—Gayle C. Ehrenman.

Plan-It Earth, \$59.95. Media Vision Multimedia Publishing; 510-770-8848.

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After Hours

items such as Graffiti, a multi-user paint program. CasinoLand, the adult section of the service, offers all the usual Vegas attractions, except Wayne Newton. You can gamble safely against the system or compete against other players.

America On-line's interface is less graphical, and most of its games are correspondingly text-oriented. Role-playing games, such as Never-Winter Nights, are popular here. Budding capital-

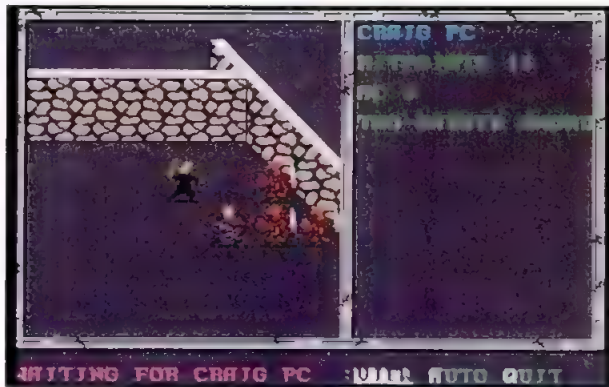
ists will enjoy the Bulls and Bears stock-market simulation, in which players bet fake money on the performance of real stocks; winning earns you free on-line time. Other enter-

tainment options rely heavily on member participation; for example, a crew of stalwarts keeps the Trivia game hopping and a dedicated band of volunteer mystics hosts the nightly

gaming. In the MTMGAMES area, you'll find a Challenge Board, which will help you find off-service modem competitors, and the Lobby, where you can find an on-line adversary for in-

service game play. For those of you who are partial to game shows, there is an offering called You Guessed It, a "Family Feud"-style multiplayer game where you compete for usage credit by guessing the most popular response to a survey question.

While you may not choose an on-line service solely on the basis of gaming options, it's nice to know that when you're ready to reach out and beat up on someone, you have a choice.



FANTASY: Role-play to your heart's content with America Online's *Advanced Dungeons & Dragons game, Forgotten Realms.*

Tarot card reading sessions.

CompuServe Information Service, the network that led the way in modem-to-modem games, offers a number of options for real-time, multiplayer

GAMES

The Hand of Fate Has Feminine Appeal

BY BARRY BRENESAL

The Hand of Fate, the second in the Fables & Fiends series, casts the graphics adventure genre in a new light. Instead of serving up the cheese-cake that parades monotonously through most games, this adventure centers on a heroine rather than a hero. Zanthia is an intelligent, two-fisted young woman who bests more than twice her weight in swamp monsters. Sure, she's a bit of a sendup, but an upbeat, nonmalicious one.

The first Fables & Fiends



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After Hours



MY HEROINE: The young, impulsive alchemist Zanthia takes a thousand-mile fall in stride in *The Hand of Fate*.

product, *The Legend of Kyrandia*, had the air of a partially finished product. There were very few characters, poorly integrat-

ed puzzles, repetitive, noninteractive backdrops, and forced attempts at humor. By contrast, there are more personalities to

interact with in *The Hand of Fate*. The humor is droll, and the puzzles are well-tied to the storyline.

The basic plot is simple: The fairytale realm of Kyrandia and everything in it has started vanishing, one tree, stone, and person at a time. Kyrandia's Order of Mystics decides to send the young, impulsive alchemist Zanthia to seek a solution at the center of the world.

It's in the visuals department, however, that this adventure outstrips all competition. You won't easily forget the two outlandishly dressed mystics chasing a giant foot around a large crater, or the abominable snowman stud who lives in a tackily furnished

cave surmounted by an icicle-encrusted disco ball. More than the satire, it's the exuberant design and detailwork in *The Hand of Fate* that impresses, providing a 256-color VGA delight in scene after scene.

Humorous, cleverly plotted and visually delightful, *The Hand of Fate* is a must for adventure-gaming enthusiasts.

The Hand of Fate, \$62.99.

Requires: 386/20-based PC or better, 2MB RAM, 17MB hard disk space, VGA display, DOS 5.0 or later, mouse; sound board recommended. Virgin Interactive Entertainment, 18061 Fitch Ave., Irvine, CA 92714; 714-833-1999.

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Pushing the Envelope of 3-D Action Gaming

**SPOTLIGHT ON
SHAREWARE**



By Neil J. Rubenking

If the U.S. Congress knew about id Software's *DOOM* and Apogee Software's *Blake Stone*:

Aliens of Gold, they'd be investi-

gating violence in computer games, not video games. The first-person viewpoint and smooth movement in these successors to the shareware smash hit, *Wolfenstein 3D*, will have you peering sideways into the monitor to see if there's a monster around the corner. Both games are available in the Hot Off The Presses section of the PBS Arcade Forum on CompuServe.

In *Aliens of Gold*, *Blake Stone* must defeat mad scientist Pyrus Goldfire and his army of humans, mutants, robots, and aliens. In *DOOM*, an anonymous space marine single-handedly opposes the forces of Hell itself. The shareware versions of these games include one mission

made up of numerous levels. The full, registered versions offer multiple missions.

Blake's missions take place in bright futuristic facilities with square-cornered rooms and level floors and ceilings, while *DOOM's* episodes are somber and

more realistic visuals, including curved walls and outdoor scenes, *Blake Stone's* sound effects are better, with different sounds for each enemy, including a despairing "Not Meeeee!" if you shoot a helpful informant.

Fans of ultraviolet shoot-'em-up games will definitely want both of these games.



BLAST IT: The Breather Beast is no match for the awesome firepower of *Blake Stone*, alien killer extraordinaire.

DOOM. Shareware, \$6; full game, \$40. Requires: 4MB RAM, 10MB hard disk space; sound board recommended. id Software, P.O. Box 538, Dallas, TX 75221, 800-434-2637, 214-828-3510; BBS, 508-368-4137.

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Blake Stone: Aliens of Gold. Shareware, \$5; full game, \$59.95 (\$10 off if you mention PC Magazine). Requires: 600K RAM, 8MB hard disk space; sound board recommended.

Apogee Software, P.O. Box 476389, Garland, TX 75049; 800-426-3123, 214-278-5655; BBS, 508-365-2359.

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eerie—in places, the only light is the flash of your bullets, and some of the enemies are nearly invisible. And where *DOOM's* advanced 3-D engine gives it

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott



It's Not Easy Being Green

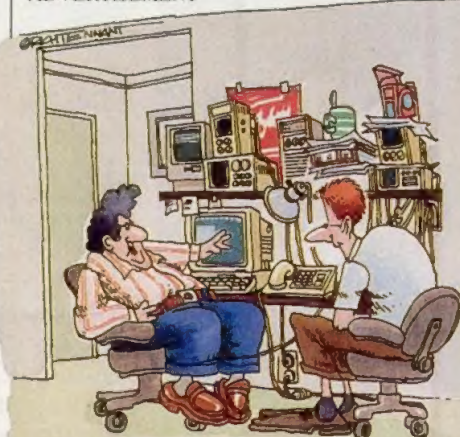
Below, MicroBase Publishing's Green Explorer software, "your blueprint to an eco-friendly world." On the left, the box it came in. And as the sun sets in the old-growth forest, another majestic tree succumbs to the cruel cuts of the screaming chain saw.



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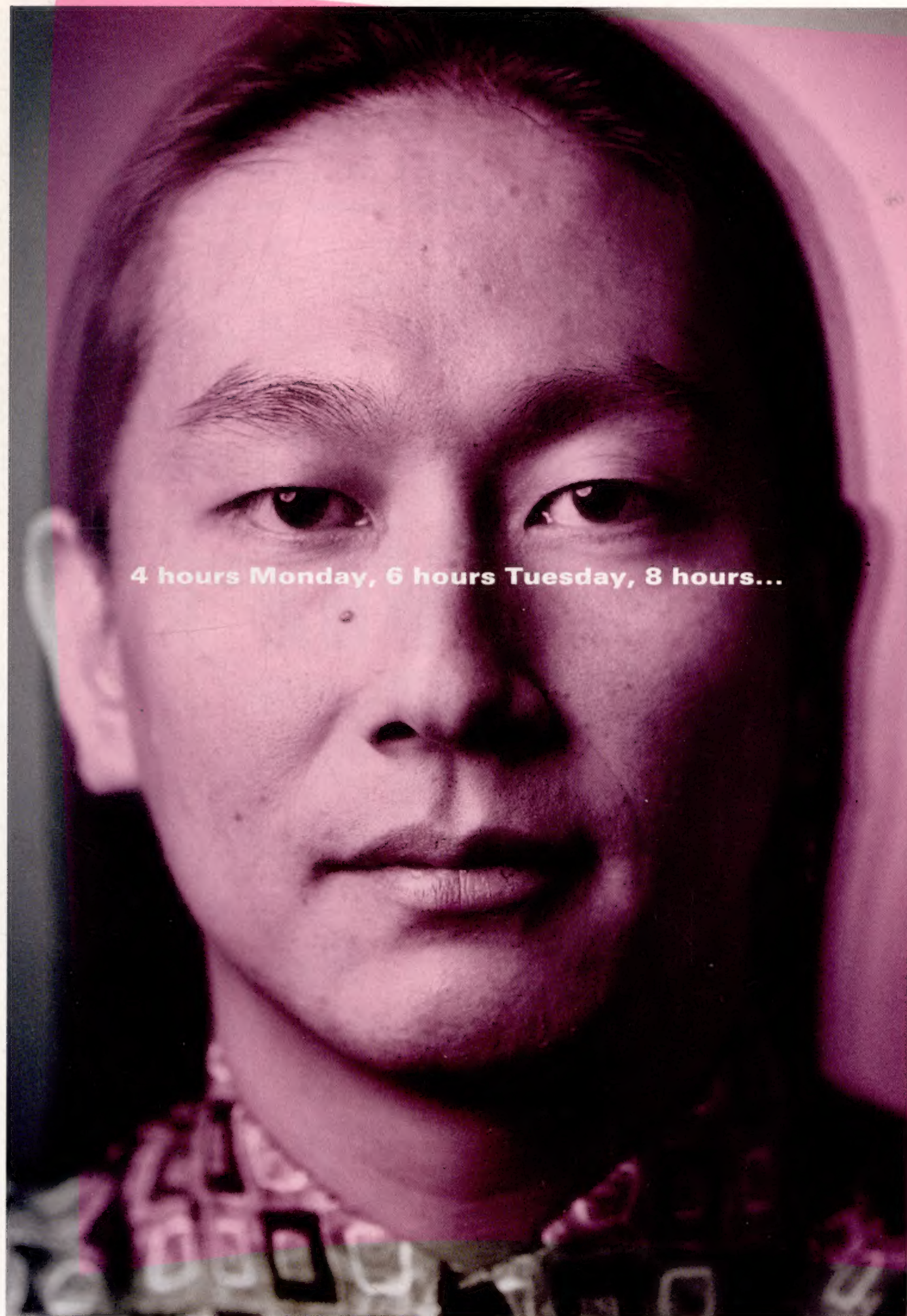
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